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ABSTRACT

Papers in this volume include the following: "The Structural Sources of Verb Meaning" (Lila R. Gleitman); "Acquisition of Noun Incorporation in Inuktitut" (Shanley Allen, Martha Crago); "Why Do Children Omit Subjects?" (Paul Bloom); "Acquiring Language in a Creole Setting: Theoretical and Methodological Issues" (Lawrence D. Carrington); "Children's Knowledge of Relative Scope in Chinese" (Yu-Chin Chien, Kenneth Wexler); "Problems in the Acquisition of Grammatical Tone" (Katherine Demuth); "Acquisition of Genitive Agents in Samoan" (Alessandro Duranti, Elinor Ochs); "Acquisition of Null Subjects and Control in Some Sinhala Adverbial Clauses" (James Gair, Barbara Lust, Lelwalla Sumangala, Milan Rodrigo); "A Sensitive Period for the Acquisition of Complex Morphology: Evidence from American Sign Language" (Dennis Galvan); "Language Acquisition of the Obligatory Contour Principle in English: Evidence from Child Language" (Heather Goad); "WH-Questions and Extractions from Temporal Adverbs: A Case for Movement" (Helen Goodluck, Julie Sedivy, Michele Foley); "The Sonority Cycle in the Acquisition of Phonology" (Gita Martohardjono); "An Acoustic Analysis of Young Children's Productions of Word Stress" (Karen E. Pollock, Diane M. Brammer, Carlin F. Hageman); "How Conservative Are Children? Evidence from Auxiliary Errors" (Karin Stromswold); and "Children's Production of Subjects: Competence, Performance, and the Null Subject Parameter" (Virginia Valian). (MSE)

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Editors' Note

This issue of *Papers & Reports on Child Language Development* contains the proceedings of the Twenty-first Annual Child Language Research Forum, held at Stanford, April 7-9, 1989. We thank all the members of the CLRF committee whose hard work made the Forum possible; Lila R. Gleitman (University of Pennsylvania) for giving the Keynote Address; Jane Edwards, Kenji Hakuta, Ann Peters, and Richard Schwartz for organizing and leading Special Interest Groups; and all the participants who contributed so much to making the meeting a success.

Next year's Forum, on **April 6-8, 1990**, will be coordinated by Miriam Butt and Tracy King. The Keynote Address will be given by **Elinor Ochs** (University of Southern California) on "Cultural Universals in the Acquisition of Language." Abstracts (limit 250 words) will be due on January 10, 1990. Abstracts and enquiries should be addressed to Coordinators/CLRF-90, Department of Linguistics, Stanford University, Stanford, CA 94305.

August 1989

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Elizabeth Owen Bratt
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Previous issues of PRCLD: Articles from previous issues of *Papers and Reports on Child Language Development* are generally available through the ERIC Document Reproduction Service, 3900 Wheeler Avenue, Alexandria, Virginia 22304, U.S.A. (Many articles that appeared in preliminary form in PRCLD have since been published in professional journals in the field.)

The structural sources of verb meaning*

Lila Gleitman

> If we will observe how children learn languages, we will find that, to make them understand what the names of simple ideas or substances stand for, people ordinarily show them the thing whereof they would have them have the idea; and then repeat to them the name that stands for it, as 'white', 'sweet', 'milk', 'sugar', 'cat,' 'dog'. (Locke, 1690, Book 3.IX.9)

Is vocabulary acquisition as straightforward as Locke supposes? Three hundred years after the publication of the *Essay on Human Understanding,* Locke's is still the dominant position on this topic for the very good reason that common sense insists that he was right: Word meanings are learned by noticing the real-world contingencies for their use. For instance, it seems obvious to the point of banality that the verb pronounced /run/ is selected as the item that means 'run' because this is the verb that occurs most reliably in the presence of running-events.

Or is it? Who has ever looked to see? One trouble with questions whose answers are self-evident is that investigators rarely collect the evidence to see if they pan out in practice.

Since this occasion of a keynote address is a serious one, I certainly am not going to try to defeat the obviously correct idea that a crucial source of evidence for learning word meanings is observation of the environmental conditions for their use. I believe, however, that what is correct about such a position is by no means obvious, and therefore deserves serious study rather than acceptance as a background fact in our field.

I'll limit the discussion to the topic of acquiring verb meanings, because this is where I and my colleagues have some experimental evidence to offer in support of the position I want to adopt. Even within this subtopic, to begin at all I will have to make critical assumptions about some heady issues which deserve study in their own right. Particularly, I will not ask where the concepts that verbs encode come from in the first place, for example, how the child comes to conceive of such notions as 'run' (or 'think' or 'chase'). I want to look at the learner at a stage when he or she can entertain such ideas, however this stage was arrived at. Second, I reserve for later discussion the question of how the child determines which word in the heard sentence is the verb -- that it is the phonological object /run/, not /horse/ or /marathoner/, that is to be mapped onto the action concept.

The topic that remains seems a very small one: How does the learner decide which particular phonological object corresponds to which particular verb concept, just Locke's topic. But I'll try to convince you that this question is harder than it looks. For one thing, matching the meanings to their sounds is the one part of acquisition that can't have any very direct "innate" support; this is because the concept 'run' isn't paired with the sound /run/ in Greek or Urdu, so the relation must be learned by raw exposure to a specific language. For another thing, and as I'll try to convince you today, it's not clear at all that the required pairings are available to learners from their ambiant experience of words and the world.

In the first half of this talk, I'll try to set out some of the factors that pose challenges to the idea that children can induce the word meanings from their contexts in the sense Locke and his descendents in developmental psycholinguistics seem to have in mind. In this discussion, I will allude repeatedly to the work and theorizing of Steve Pinker, because he seems to me to be the most serious and acute modern interpreter of ideas akin to Locke's in relevant regards. Then, in response to these challenges to the theory of learning by observation, I will sketch a revised position laid out by Landau and Gleitman (1985), illustrating it with some recent experimental evidence from our laboratory. The idea here is that, to a very considerable extent, children deduce the verb meanings by considering their syntactic privileges of occurrence. They must do so, because there is not enough information in the whole world to learn the meaning of even simple verbs.

Part I: Some difficulties of learning by observation

Locke's idea: Differences in experience should yield differences in meanings

At peril of carricaturing Locke -- but who doesn't? -- I select him as one who argued for a rather direct relation between knowledge and the experience of the senses. He frequently used the example of individuals born without sight as a testing ground for such a position. According to Locke, sighted and blind people ought both to be able to learn the meanings of such words as statue and feel and sweet, but the blind ought to be unable to acquire picture and see and red, for these concepts are primitive (i.e., not derivable from other concepts) or derivable from primitives that are available only to the eye.

Barbara Landau and I were directly inspired by Locke to study the acquisition of these vision-related terms by blind babies (Landau and Gleitman, 1985). As our studies evolved, we realized that exactly the same conceptual issues about learning arise for sighted vocabulary learners as for blind ones, so I will move on to discussion of such normally endowed children. The blind population, which I discuss first, is perhaps special only as the biographical point of origin of our own thinking but I suspect that, for you listeners too, it will serve to dramatize some issues which seem less startling in the ordinary case. These have to do with how resistant the word-learning function is to the evidence of the senses.

Landau and I were astonished to discover how much alike were the representations of vision-related terms by blind and sighted children at age 2 1/2 or so, despite what would appear to be radical differences in their observational opportunities. For instance, all these babies showed by their comprehension performances that they took look and see as terms of perception, distinct from such contact terms as touch. As an example of this, a blind child told to "Touch but don't look at..." a table would merely bang or tap it. Whereas if told "Now you can look at it" she explored all its surfaces systematically with her hands. Moreover, she understood look to be the active (or exploratory) and see the stative (or achievement) term in this pair. Just as surprising, blind children as well as sighted children understood that green was an attribute predicable only of physical objects (they asserted that ideas could not in principle be green while cows might be, for all they knew). Thus the first principle that a theory of observational learning must be subtle enough to capture is that

(i) The same semantic generalizations can be acquired in relative indifference to differing environmental experience, if the notion "experience" is cast in sensory-perceptual terms.

Can word-to-world pairings in the input account for the child's semantic conjectures?

While we found the surprising result that blind children shared much knowledge about vision-related terms with their sighted peers, we also achieved the unsurprising result that there were some differences in how these two populations understood these terms to refer to their own perceptions: Blind children think that look and see describe their own haptic perceptions while sighted children think these same words describe their own visual perceptions. Thus blindfolded sighted children of 3 years look skyward if told to "Look up!" but a blind child of the same age holds its head immobile and searches the space above in response to the same command (see Figures 1 and 2).[1]

This outcome is of just the sort that is subject to "obvious" explanations involving the extralinguistic contexts of use. We reasoned (as does everyone to whom one presents this set of facts): 'Obviously,' a blind child's caretaker will use the terms look and see intending the child to perceive in whatever ways her sensorium makes available. And since the blind child's way of discovering the nature of objects is by exploring them manually, the caretaker will surely use look and see to this child only when an object is near enough to explore manually. That is, the caretaker should say "Look at this boot" to her blind baby only if a boot is nearby, ready to be explored manually. The contexts of use for these words thus should include -- among many other properties -- conversationally pertinent objects that are near at hand. Had the caretaker instead rattled a boot noisily by the child's ear whenever she said "Look at this boot", the learner would have surmised that look means 'listen'.

So here we have a straightforward prediction from the environment of use to the formation of a semantic conjecture: By hypothesis, the blind learner surmises that look involves haptic exploration because it is that verb which is used most reliably in contexts in which haptic exploration is possible and pertinent to the adult/child discourse. Landau and I decided to test that prediction to see if it was as true as it was obvious.

To do so we examined videotapes of a mother and her blind child recorded in the period before the child uttered any vision-related words or indeed any verbs at all (that is to say, during the learning period for these words), coding all verb uses according to whether they occurred when an object pertinent to the conversation (a) was NEAR enough to the child for her to explore it manually, i.e., within arm's reach, (b) was FARther away than that, or (c) when there was NO such pertinent OBJECT. We hypothesized that look and see were the verbs used most reliably in the NEAR condition accounting for why the child had

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[1] A related difference holds for the color words. Sighted children of four and five map the color words onto observed hues in the world while blind children ask for help. Perhaps they think the property is stipulative. Asked "Why are the flowers in the woods pink?" one blind child responded "Because we name them pink!" (Landau, personal communication). They know these are attributes predicable only of physical objects (they say that an idea can't be green because "it's only in your head") but they don't know what the real-world dimension may be. Interestingly, they avoid some choices that their extralinguistic experience appears to make available, e.g., that color terms refer to sizes of objects (Landau and Gleitman, ibid, ch. 8).

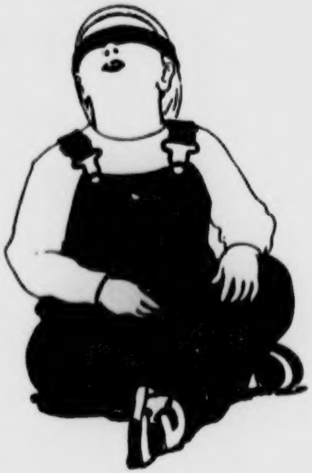

Figure 1: A blindfolded sighted child's response to the command "Look up!" (from Landau and Gleitman, 1985)

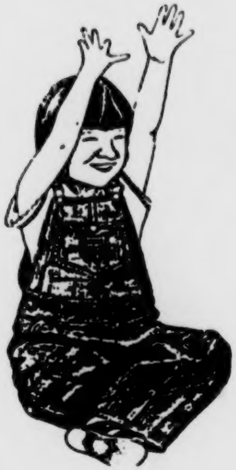

Figure 2: A blind child's response to the command "Look up!" (from Landau and Gleitman, 1985)

assigned them the meanings 'explore/apprehend manually' (while other verbs would be used less often in this condition, and so would not be assigned a haptic component in their meanings).

The results are shown in Table 1. They fail to account for the child's haptic interpretation of look and see. Put and give and hold are the verbs used most reliably (over 95% of the time) under the NEAR condition while look (73%) and especially see (39%) are not as reliably associated with this condition. We can conclude that

> (ii) If representations of the environmental contexts are the basis for the semantic conjectures, these can't can't be just the simplest and most obvious representations of those contexts that one can think of.

It is worth pointing out before leaving this topic that the analysis of Table 1 cannot be written off as of some environmental property that is hopelessly irrelevant to the child's analysis of events (though it is doubtless too simple, a fact to which I will return directly). For as it stands, this analysis extracts and explains important distinctions among verbs of physical motion that are in other respects semantically close, such as give vs get. The child is apparently told, sensibly enough, to give what she has in hand (this verb is used in the NEAR condition 97% of the time) but to GET what she doesn't have (the relevant NEAR percentage for this verb is 45%).

Latitude of the hypothesis space

Generalization (ii) brings me closer to topics I want to concentrate on today. Notice that the conclusion drawn was very weak -- not that it wasn't the contexts that led to the learning, but rather that the idea of "real-world context," to succeed, must be a good deal more subtle than we (and others) originally supposed. That is, the response to the findings shown in Table 1 is usually, and perhaps should be:

"Oh, but the contextual analysis you imposed was so feeble. Showing that it failed is only showing the failure of Landau and Gleitman's imagination. The child surely imposes a richer analysis on the situation than that, and the only analysis relevant to the hypotheses under test is the one that the child herself imposes."

Fair enough. We limited the child to observing some perceptually obvious features of the situation, features that the infancy literature tells us are available even to babies. In other words, our aim was to see how far some small and independently documented set of observational primitives could get the learner in extracting simple meaning features for assignments to the verbs. These were that the world is

Verb	Proportion used in contexts In hand or near	 Far	 No object	Total number considered[a]
Perceptual verbs				
Look	.73	.09	.18	34
See	.39	.56	.05	18
Other perceptual	.56	.44	.00	17
Nonperceptual verbs				
Come	.05	.32	.63	19
Get	.50	.25	.25	27
Give	.97	.03	.00	21
Go	.52	.24	.24	20
Have	.53	.47	.00	11
Hold	1.00	.00	.00	10
Play	.70	.00	.30	10
Put	.97	.00	.03	61
Say	.43	.07	.50	28

a. These total to N=276, the number of utterances containing the common verbs (10 or more occurrences in the maternal corpus). The remaining 389 were discarded in this and following analyses, including 183 instances of *be* and 186 instances of rare verbs (fewer than 10 occurrences).

Table 1: Situational contexts for the common verbs used by the blind child's mother during the learning period (from Landau and Gleitman, 1985)

populated with objects which endure over time (Spelke, 1982), and which move relative to each other (Lasky & Gogol, 1978) and with respect to the positions of the child's own body (Acredolo and Evans, 1980; Field, 1976). These assumptions put the child in a position to conceive of the situation as one of objects--in this case, objects whose noun names are known to the child--moving (as described by the verb) between sources and goals. For example, for give the object moves from NEAR as action begins to FAR when it ends, and in get the object goes from FAR to NEAR.[2]

It can hardly be denied, in light of the infancy evidence, that youngsters do represent situations in terms of the positions and motions of pertinent objects. What is surely false, however, is that such categories are exhaustive amongst the child's extralinguistic analyses. Infants come richly prepared with means for picking up information about what is going on in their environment -- looking, listening, feeling, tasting, and smelling; in fact these different sensory routes appear to be precoordinated for obtaining information about the world (Spelke, 1979). To take a few central examples, infants perceive the world as furnished with objects which are unitary, bounded, and persist over time and space (see Gibson and Spelke, 1983), and which cannot occupy two places at one time (Baillargeon, Spelke, and Wasserman, 1985). They distinguish among the varying properties of objects, e.g., their rigidity or elasticity (Gibson and Walker, 1984), their size (Golinkoff et al, 1984a), their colors (Bornstein, 1975), whether they are moving or stationary (Ball and Vurpillot, 1976), their positions and motions relative to the child observer (Field, 1976), their animacy (Golinkoff et al, 1984b) and even their numerosity (Starkey, Gelman, and Spelke, 1983). If you think there's something that infants can't or won't notice, look in the next issue of Developmental Psychology and you will probably discover that someone proved they can.

Now that I have acknowledged something of the richness of infant perception, why not let the learner recruit this considerable armamentarium for the sake of acquiring a verb vocabulary? That is, why not assume that the child encodes the situation not only in the restricted terms that yield Table 1, but in myriad other ways? For instance, over the discourse as a whole, probably the mother has different aims in mind when she tells the child to "look at" some object than when she tells her to

---

[2] We hasten to say such an analysis can succeed at all only if the child can determine the discourse addressee. This assumption is plausible because (1) in these transcripts, at least, the mother's speech is over 95% about the "here and now" and (2) in over 90% of instances, the addressee is the child herself.

"hold" or "give" it. The child could code the perceptual world for these perceived aims and enter these properties as aspects of the words' meanings. But also the mother may be angry or distant or lying down or eating lunch and the object in motion may be furry or alive or large or slimy or hot, and the child may code for these properties of the situation as well, entering them too as facets of the words' meanings.

The problems implicit in such an expansion of the representational vocabulary should be familiar from the literature on syntax acquisition: The trouble is that an observer who notices everything can learn nothing, for there is no end of categories known and constructable to describe a situation.[3]

Indeed, not only learnability theorists but all syntacticians in the generative tradition appeal to the desireability of "narrowing the hypothesis space" lest the child be so overwhelmed with representational options and data-manipulative capacity as to be lost in thought forever. At least, learning of syntax could not be as rapid and uniform as it appears to be, unless the child were subject to highly restrictive principles of Universal Grammar, which rein in her hypotheses. As one famous example, the learner is said to assume that all syntactic generalizations are structure-dependent rather than serial-order dependent (Chomsky, 1975; see also Crain and Fodor, in press). In fact, Universal Grammar is said to be as constrained as it is owing to the child's requirement that this be so.

I put it to you: Are these observations about the difficulties of learning when the hypothesis space is vast no less true of word learning than of syntax? In the domain of vocabulary acquisition as much as that of syntax acquisition, there is remarkable efficiency and systematicity of learning across individuals (and, as the blind children show, across learning environments): The rapidity and accuracy of vocabulary acquisition are jewels in the crown of rationalistically oriented developmental psycholinguistics (see particularly Carey, 1982). So just as in the case of syntax, we have initial grounds for claiming that a limit on the hypothesis space must be a critical source of sameness in the learning function. Bolstering the same view, languages seem to be as alike in their elementary vocabularies as they are in their syntactic devices (see for example Talmy, 1975; 1985). But surprisingly enough, all the telling arguments, invoked for syntax, to restrict the interpretation of the input -- that is, constraints on representations -- that are to explain these samenesses in form, content, and learning functions, are thrown out the window in most theorizing about the lexicon. There it is usually maintained that the child considers many complex, varying, cross-cutting, subtle conjectures about the scenes and events in view so as to arrive at the right answers, comparing and contrasting possibilities across many events, properties, discourse settings, and so forth. In other words, testing and manipulating an exceedingly broad and free-ranging hypothesis space.

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[3] As so often, Chomsky (1982) sets the problem with great clarity: "...The claim we're making about primitive notions is that if data were presented in such a way that these primitives couldn't be applied to it directly, prelinguistically before you have a grammar, then language couldn't be learnt...And the more unrealistic it is to think of concepts as having those properties, the more unrealistic it is to regard them as primitives ...We have to assume that there are some prelinguistic notions which can pick out pieces of the world, say elements of this meaning and of this sound." The analysis of Table 1 is an attempt to see how far some small and independently documented set of observational primitives could get the learner in extracting a simple meaning feature ('haptic') for assignment to certain verbs.

A very few investigators have been responsive to the issues here. Pinker (1987), in a direct and useful discussion of the requirement to limit the space of observables that a learner will consider in matching the event to the unknown verb, writes as follows:

> Verbs' definitions are organized around a surprisingly small number of elements: "The Main Event", that is, a state or motion; the path, direction, or location of an object, either literal spatial location or some analogue of it in a nonspatial semantic field; causation; manner; a restricted set of the properties of a theme or actor; temporal distribution (aspect and phase); purpose; coreferentiality of participants in an event; truth value (polarity and factivity); and a handful of others.
>
> (1987, p. 54)

It is an open question whether Pinker's proposed list is narrow enough to meet the requirement for a realistic set of primitives upon which a verb-learning procedure can operate. Are purposes, truth values, causes, not to speak of "analogues of spatial location in nonspatial semantic fields" really primitives that inhere in the observations themselves? It seems to me highly unlikely that any choice of perceptual constraints will be restrictive enough to delimit the analyses a child performs in reaction to each event/ verb pair. Of course I'm not suggesting that there aren't principles of perception that are restrictive and highly structured (God forbid!). But they are likely not restrictive enough to account for vocabulary acquisition. How could they be? Perception has to be rich enough to keep the babies from falling off cliffs and mistaking distant tigers for nearby pussycats lest they all disappear from the face of the earth before learning the verb meanings.

However, the richness of perception is not the only, or even the major, problem faced by a hypothetical learner who tries to acquire verb-meanings from observation. The more difficult problem is that even the homeliest and simplest verbs, though they refer to events perceivable, encode also the unobservable present interests, purposes, beliefs, and perspectives of the speaker. I turn now to this class of problems.

Perspectives on events

Consider the learning of simple motion verbs, such as push or move. In a satisfying proportion of the times that care-caretakers say something like "George pushes the truck," George can be observed to be pushing the truck. But unless George is a hopeless incompetent, every time he pushes the truck, the truck will move. So a verb used by the caretaker to describe this event may represent one of these ideas ('push') or the other ('move').

Moreover, every real event of the pushy sort necessarily includes, in addition to the thrust and goal, various values of trajectory, rate, and so forth, so that such ideas as 'slide,' 'rumble,' 'roll,' 'crawl,' and so on, are also relevant interpretations of a new verb then uttered. What is left open by the observation is whether that verb represents any or all of these manner differences: no, in the case of push, but yes in the case of roll or rumble.

Note that the manner elements just mentioned do fall within the range encoded by verbs in many languages (Talmy, 1985) and are on the narrowed list of perceptual properties suggested by Pinker (1987). I leave aside various other interpretations often called "less salient" (i.e., I ignore more general consideration of the "stimulus-free" character of language use; see Chomsky, 1959), especially the countless zany interpretations of this event that could be drawn by worried philosophers.[4]

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[4] Jerry Fodor has suggested to me, maybe seriously, that these problems go away because the caretaker and child are in cahoots, and they are mind-readers. They are so attuned in discourse, being creatures of exactly the same sort, that the child zaps onto exactly the characteristics of the situation that the mother, just then, has in mind to express (see Bruner, 1974/5 for a story about how the attentional conspiracy is set up by mother and child, and Slobin, 1977, for a related account of the conversational environment). A related position is maintained by Pinker (citing Keenan) about situations the learner might select as learning opportunities; in the case

It is plausible that these ambiguities are eliminated by looking at a verb's uses across situations (see again Pinker, 1987). There will eventually be some instance of moving called /push/ in which the truck is moving rapidly, eliminating 'crawl' as a conjecture about the meaning of this item, etc. By a process of cross comparison and elimination, each verb may eventually be distinguishable. The worry is only that the burden of hypothesis testing is becoming ominous as the comparison set (of verbs, properties, and scenes) enlarges.[5]

Difficult problems can be solved. But impossible ones are harder. Consider such verbs as flee and chase, buy and sell, win and beat, give and get, and so on. Such pairs are common in the design of verb lexicons. Each pair alludes to a single kind of event: Whenever the hounds are chasing the fox, the fox is fleeing from the hounds. If some hounds are racing, even with evil intentions, toward a brave fox who holds its ground, they can't be said to be chasing him. Chasing implies fleeing, necessarily. If the child selects a verb from the stream of speech accompanying such a scene, how then is she to decide whether it means 'chase' or 'flee'?

Pinker is discussing, the child is to discover the property subject from its semantic/pragmatic environmental correlates:

> The semantic properties of subject hold only in basic sentences: roughly, those that are simple, active, affirmative, declarative, pragmatically neutral and minimally presuppositional...The parents...or the child might filter out nonbasic sentences from the input using various contextual or phonological diagnostics of nonbasicness such as special intonation, extra marking on the verb, presuppositions set up by the preceding discourse or the context, nonlinguistic signals of the interrogative or negative illocutionary force of an utterance, and so on. (Pinker, 1984, pp 46/7).

Note again the number and nontransparency of the experiential analyses necessary within this perspective.

[5] I may well be granting too much here. After all, touching, and even breathing and existing are going on in the presence of all moving and pushing events. So it's probably not true that a unique interpretation of verbs from scenes can ever be extracted, whatever the ornateness of the scene-storage and manipulation procedures may be. Not at least without invoking notions of "salience" which is likely just substitution of unknowns for unknowns.

Such examples are thrusts to the heart of the observational learning, hypothesis. As Pinker (1987, p. 54) acknowledges, "Basically, we need to show that the child is capable of entertaining as a hypothesis any possible verb meaning, and that he or she is capable to eliminating any incorrect hypothesis as a result of observing how the verb is used across situations." But chase and flee (and a host of similar pairs) are relevantly used in all and only the same situations. It follows that it cannot be shown that the child is capable of eliminating the incorrect hypotheses by cross-situational observation.

I think the problem is that words don't describe events simpliciter. If that's all words did, we wouldn't have to talk. We could just point to what's happening, grunting all the while. But instead, or in addition, the verbs seem to describe specific perspectives taken on those events by the speaker, perspectives which are not "in the events" in any direct way. How far are we to give the learner leave to divine the intents of his elders as to these perspectives? Are they talking of hounds acting with respect to foxes, or of foxes with respect to hounds?

Speaking more generally, since verbs represent not only events but the intents, beliefs, and perspectives of the speakers on those events, the meanings of the verbs can't be extracted solely by observing the events.

The subset problem

A related problem has to do with the level of specificity at which the speaker, by the words he chooses, refers to the world. Consider the homely little objects in the world, the pencils, the ducks, the spoons. All these objects are supplied with more than one name in a language, e.g., animal, duck, Donald Duck. I expect that the adult speaker has little difficulty in selecting the level of specificity he or she wants to convey and so can choose the correct lexical item to utter in each case. And indeed, the learner may be richly pre-equipped perceptually and conceptually so as to be able to interpret scenes at these various levels of abstraction, and to construct conceptual taxonomies (Keil, 1979). But as usual this very latitude adds to the mystery of vocabulary acquisition, for how is the child to know the level encoded by the as yet unknown word? The scene is always the same if the child conjectures the more inclusive interpretation (that is, if her first conjecture is animal rather than duck). For every time there is an observation that satisfies the conditions (whatever these are) for the appropriate use of duck, the conditions for the appropriate use of animal have been satisfied as well.

Analogous cases exist in the realm of verb meanings. To return to the instance dramatized by the blind learners, perceive, see, look, eye (in the sense of 'set eyes on'), face, orient, pose the same subset problem. There is no seeing without looking, looking without facing, facing without orienting, etc. All this suggests that not only blind children, but sighted children as well, should have (essentially the same) difficulties in learning the meanings of look and see, because the distinction between the two words is not an observable property of the situations in which they are used. Yet, as I discussed earlier, it is just these "unobservable" properties that the blind and sighted three year olds held in common.

Gold (1967) addressed a problem that seems related to this one. He showed formally that learners who had to choose between two languages, one of which was a subset of the other, could receive no positive evidence that they had chosen wrong if they happened to conjecture the superset (larger) language. This is because the sentences they would hear, all drawn from the subset, are all members of the superset as well. It has therefore been proposed that learners always hypothesize the smaller (subset) language; they initially select the most restrictive value of a parameter on which languages vary (Berwick, 1981; Wexler and Manzini, 1987).

But the facts about the lexicon do not allow us to suppose that the child has a solution so simple as choosing the least inclusive possibility. In the end, they acquire all of them. Moreover, neither the most inclusive nor the least inclusive possibilities seem to be the initial conjectures; rather, some "middle" or "basic" level of interpretation is the one initially selected, i.e., duck and look (as opposed to mallard and glimpse seem to be the real first choices of the learners.[6]

In short, words that stand in a subset relation pose an intractable problem for an unaided observation-based learning procedure. This is because the child who first conjectures the more inclusive interpretation can receive no positive evidence from word-to-world mappings that can dissuade him. And the idea that he always begins with the least inclusive interpretation consistent with the data is falsified by the empirical facts.

Many semantic properties are closed to observation

But the verbs that most seriously challenge the semantic bootstrapping proposal still remain to be discussed: These are the ones that don't refer to the observable world at all.

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[6] These results can't be written off on grounds of the differential frequency of these words in the input corpus, for if the frequencies are changed the level of categorization does not. For instance, in some houses Fido is a more frequent word than dog, but in that case the youngest children think that the word meaning 'dog' is /faydo/ (Rescorla 1980).

Locke noted that the meanings of many words involve properties that are closed to observation, but he did not consider this fact to be fatal to his overall position because his experience, partly warranted, was that those who used such "abstract" words didn't know what they were talking about half the time anyhow. Nevertheless a key problem for an unaided observational-learning story is that too many words that even a three or four-year old understands are related to the real world only in the most obscure and unobservable ways, if at all. Try, for example, to learn the meaning of the word think by titrating discourse situations into those in which thinking is going on, somewhere, when you hear /think/, vs those in which no thinking is happening. Remember that there isn't always brow-furrowing or a Rodin statue around to help. Keep in mind also that you are going to have to distinguish also among think, guess, wonder, know, hope, suppose and understand, not to speak of -- a few months or years later -- conjecture, figure, comprehend, discover, perceive, etc.

Many developmental psycholinguists rule such instances out of school on the grounds that these aren't words that children know very well at two and three years old, but this won't do. After all, we also want to understand the children who manage to survive to become the four and five year olds.

I don't really think this topic needs much more belaboring. If the child is to learn the meanings from perceptual discriminanda in the real world, the primitive vocabulary of infant perception has to be pretty narrow to bring the number and variety of data storing and manipulative procedures under control. But no such narrow vocabulary of perception could possibly select the thinkingness properties from events. I conclude that an unaided observation-based verb learning theory is untenable because it could not acquire think.

Summary

I've mentioned a number of problems for a theory that (solely or even primarily) performs a word-to-world mapping to solve the vocabulary learning task. These are that (i) such a theory fails to account for the fact that children whose exposure conditions are radically different acquire much the same representations of many words; (ii) plausible, narrowly drawn, candidates for event representation seem to be inadequate in accounting for the learning in certain apparently easy cases; (iii) broadening the hypothesis space so as to allow learners to distinguish among the many verb meanings may impose unrealistic storage, manipulation, and induction demands on the mere babes who must do the learning. In addition, (iv) many verbs are identical in all respects except the perspectives that they adopt toward events or (v) the level of specificity at which they describe a single event; or (vi) don't refer to events and states that are observable at all. Since children learn the verb meanings despite these apparently formidible problems, my conjecture is that they have another source of information that redresses some of the insufficiencies of observation.

Part II: New approaches for vocabulary acquisition

How the blind child might have learned the visual terms

I return now to the problem Landau and I faced in understanding the blind child's semantic achievements. Keep in mind that the analysis of Table 1 was an attempt to explain only the most straightforward, perceptually relevant, aspect of her acquisition of look and see, namely that if these verbs had to do with haptic perception, there must have been pertinent objects close to her hands when her mother said those words. Yet even this simple idea seemed to be falsified by our analysis.

To find out why, our first step was to return to the data of Table 1 to see where and when the NEARNESS constraint had failed for so many uses of look and see. We found that the sentences that fell neatly under the object-nearby conjecture were very simple ones: If the mother had said something like

Look at this boot!
or See the apple?

invariably the boot or apple were NEAR, within the blind child's reach. But if the mother said

Let's see if Granny's home! (while dialing the phone)
Look what you're doing!
You look like a kangeroo in those overalls.
or Let's go see Poppy.

the "pertinent object" was likely to be FAR or there was NO such pertinent OBJECT intended. Clearly, the sentences that tripped up our simple story were queer ones indeed. The mother didn't seem in most of these cases to mean 'examine or apprehend' either haptically or visually, but rather 'determine', 'watch-out', or 'resemble.' Or else, as in the final example, a motion auxiliary (go) in the sentence transparently took off the NEARbyness requirement.

There are two ways to go now: One can claim that the NEARbyness environmental clue to the haptic interpretation was just a snare and delusion -- but that is ridiculous. It just HAS to be right that this aspect of the environment was part of what licensed the child's haptic interpretation. The other choice is to find some non-question-begging way through which the child could have gotten rid of the sentences that otherwise would threaten the experiential conjecture. (The question-begging way, of course, is to say that the mother didn't mean 'haptically explore' in the offending sentences).

How can this be done? The clue is that not only the meaning, but the syntax too, of these offending sentences is special -- different from the syntax of sentences in which the child was really being told to explore and perceive nearby objects. This syntactic distinction may be available to the learner.

A syntactic partitioning of the verbs commonly used by the mother of the blind baby (based on the same corpus analyzed in Table 1), according to the subcategorization frames in which each verb appeared in the maternal corpus, is shown in Table 2; the verbs of Table 1 appear as the columns in this table, and the syntactic environments appear as the rows; the numbers in each cell are the number of instances of a verb in some particular syntactic environment.[7] Notice first that some of the typical syntactic environments for look and see are quite different from those for the other verbs in the set.

Moreover, we can -- with only a little fudging -- divide the environments of the vision-related verbs so as to pull apart those environments in which the NEARbyness contextual cue holds, and those in which it does not: That analysis is shown in Table 3. Essentially, the top rows of Table 3 show the maternal uses of these verbs in their canonical subcategorization frames (e.g., "Look at/see the frog," "Look up/down") and the deictic interjective uses that are the most frequent in that corpus (e.g., "Look!, That's a frog!" and "See?, That's a frog!"). When these syntactic types only are considered, the NEAR proportion of look rises (to 100%, from 73% in Table 1) and so does the NEAR proportion of see (to 72% from 39%). Thus if the learner can and does perform these analyses, the first result is that NEARbyness of the pertinent object becomes a much more reliable real-world clue than previously. But notice that the hypothesis now is that the child performs a sentence-to-world mapping, rather than the word-to-world mapping shown in Table 1: The child's interpretation of extralinguistic events has been significantly modulated by her attention to linguistic events, namely the syntax.

Landau and I made yet another, and much stronger, claim based on the kinds of outcomes shown in Table 2. This was that

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[7] Specifically, the rows of this table represent subcategorization frames, the sister-nodes to V under the verb phrase.

	Group I		Group II				Group III			
	Look[a]	See[a]	Give[a]	Put[a]	Hold[a]	Play	Get[a]	Have	Go[a]	Come[a]
Look/see only										
Deictic										
V!	8									
V?		1								
V!, S	10									
V?, S		3								
V rel_{how}	2									
Other										
V like NP	5									
V S		5						1[b]		
come V NP		3								
Exclude *look/see*										
V NP PP			5	31	1		2			
V NP D				28	6		2			
V D NP				1						
V NP NP			16				2			
V rel_{where}				1						
Overlap with *look/see*										
V PP	3					7[c]			2	2
V D	2						5		10	13
V ∅	2	3							8	4
V NP		3			3	3	13	14		
V AP	2						3			
Totals	34	18	21	61	10	10	27	15	20	19

a. Verbs that occur with locative prepositions and adverbs.

b. A causative use of *have*: "Will we have Barbara come baby sit?"

c. *Play* with the nonlocative (reciprocal) preposition *with*: "You're not gonna play with the triangle, so forget it!"

Table 2: Subcategorization privileges of the common verbs used by the mother of a blind child during the learning period. The number in each cell represents the number of times that a verb is used in a particular frame environment (from Landau and Gleitman, 1985)

the range of subcategorization frames has considerable potential for partitioning the verb set semantically, and that language learners have the capacity and inclination to recruit this information source to redress the insufficiencies of raw observation. This examination of structure as a basis for deducing the meaning is the procedure we've called "syntactic bootstrapping." I turn now to a comparison of the hypothesis called "semantic bootstrapping" by Pinker to the one called "syntactic bootstrapping" by Landau and me.

The bootstrapping proposals compared

The two bootstrapping proposals are much alike in what they claim about correspondances between syntax and semantics, and are also alike in proposing that the child makes significant use of these correspondances. First I'll sketch, very briefly and informally, the kinds of syntactic/semantic correspondances that are crucially invoked in both proposals.

Syntactic/semantic linking rules: To an interesting degree, the structures in which verbs appear are projections from their meanings. To take a simple example, the different number of noun-phrases required by the verbs laugh, smack, and put in the sentences

(1) Arnold laughs.
(2) Arnold smacks Gloria.
(3) Gloria puts Arnold in his place.

is clearly no accident, but rather is semantically determined--by how many participant entities, locations, etc., the predicate implicates. Similarly, the structural positions of these noun-phrases relative to the verb also carries semantic information; thus, much more often than not the subject noun-phrase will represent the actor or causal agent (e.g., Arnold in sentence 1 and Gloria in sentence 2), and paths and goals will appear in prepositional phrases (in his place, in sentence 3). These links of syntactic position and marking to semantic properties, while by no means unexceptional, typify the ways that English represents semantic-relational structure. In short, verbs that are related in meaning share aspects of their clausal syntax. Zwicky (1971) put the idea this way:

> "If you invent a verb, say greem, which refers to an act of communication by speech and describes the physical characteristics of the act (say a loud, hoarse, quality), then you know that...it will be possible to greem (i.e. to speak loudly and hoarsely), to greem for someone to get you a glass of water, to greem at your sister about the price of doughnuts, to greem "Ecch" at your enemies, to have your greem frighten the baby, to greem to me that my examples are absurd, and to give a greem when you see the explanation."

Semantic bootstrapping: Using the semantics to predict the syntax: As I mentioned earlier, both the bootstrapping proposals make critical use of these canonical relations between syntax and semantics. In the semantic bootstrapping procedure, the child fixes the meaning of a verb by observing its real-world contingencies. In Pinker's (1987) words:

> "...the child could learn verb meanings by (a) sampling, on each occasion in which a verb is used, a subset of the features...[8], (b) adding to the tentative definition for the verb its current value for that feature and (c) permanently discarding any feature value that is contradicted by a current situation."

I have argued at length that this position is too strong, for at least some features are unobservable. Yet no one can doubt that, at least sometimes, the context of use is so rich and restrictive as to make a certain conjecture about interpretation overwhelmingly likely.[9]

Once the verb meaning has been extracted from observation, the semantic bootstrapping hypothesis invokes the linking rules (the canonical syntactic/semantic mappings) to explain how the child discovers the structures which are licensed for the use of these verbs, much in the spirit of Zwicky's comments about the invented word greem. For instance, if a verb has been discovered to mean give, then it will appear in three-argument structures such as John gives the book to Mary. This is because the logic of 'give' implies one who gives, one who is given, and that which is given, and each of these entities requires a noun-phrase to express.

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[8] The features are those mentioned in my earlier citation of Pinker (page 10 of this manuscript).

[9] At peril of making one argument too many, however, I can't resist complaining that Pinker's proposed procedure is too extreme. After all, sometimes the child is attending to one thing (say, the dog under the table) when the mother says something irrelevant to that (say, "Eat your peas, dear!"). So the learner better not "discard permanently" any feature that contradicts the current situation as he or she is conceiving it. In fact, positive imperatives pose one of the most devastating challenges to any scheme that makes word-to-world pairings for the mother will utter "Eat your peas!" if and only if the child is not then eating his peas. Thus a whole class of constructions seems to be reserved for saying things that mismatch the current situation.

Not only is this position plausible. There is much evidence in its favor. Notably, Bowerman (1976; 1982) showed that children will make just such predictions about the syntactic structures licensed for verbs, presumably based on their prior fixing of the verb meanings: That evidence came from instances where children's conjectures were evidently too bold or insufficiently differentiated; that is, where they were wrong -- but still understandable. For instance, a subject of Bowerman's commanded "Don't eat the baby -- she's dirty!" on an occasion when the mother was about to feed the baby (whose diaper needed changing). Presumably, the child had conjectured that an intransitive motion verb (e.g., _sink_, as in _The ship sank_) could be uttered in a transitive structure (such as _The captain sank the ship_) to express the causal agent of this motion.

To summarize, the semantic bootstrapping procedure as developed by Grimshaw (1981), Pinker (1984) and others, works something like this: The child is conceived as listening to the words used, and then trying to figure out their meanings by observing their situational concomitants, the word-to-world pairing that I've discussed. Quoting Pinker (1984) again,

> If the child deduces the meanings of as yet uncomprehended input sentences from their contexts and from the meanings of their individual words, he or she would have to havve learned those word meanings beforehand. This could be accomplished by attending to single words used in isolation, to emphatically stressed single words, or to the single uncomprehended word in a sentence...and pairing it with a predicate corresponding to an entity or relation that is singled out ostensively, one that is salient in the discourse context, or one that appears to be expressed in the speech act for which there is no known word in the sentence expressing it (p. 30).

Once the meanings have been derived from observation, the child can project the structures from her (innate) knowledge of the rules that map semantic structures onto syntactic structures (by procedures variously called _mapping rules, linking rules, projection rules,_ or _semantic redundancy rules_). Perhaps so, but I have been arguing that entities and relations cannot in general be singled out ostensively, that "salience" and the question of what's "expressed in the speech act" are not so easily recoverable as this perspective must insist. For such reasons, Landau and I developed a procedure that looks quite different from this.

Syntactic bootstrapping: The syntactic bootstrapping proposal in essence turns semantic bootstrapping on its head. According to this hypothesis, the child who understands the mapping rules for semantics onto syntax can use the observed syntactic structures as evidence for deducing the meanings. The child is conceived as having certain concepts in mind, say, 'look' or 'put', and is engaged in a search for the words that express these concepts. To accomplish these aims, the child observes the real-world situation but also observes the structures in which various words appear in the speech of the caretakers. That is to say, the child performs a sentence-to-world pairing rather than a word-to-world mapping. Such a procedure can succeed because, if the syntactic structures are truly correlated with the meanings, the range of structures will be informative for deducing which word (qua phonological object) goes with which concept. Such a procedure will be quite handy if, as I have argued, raw word-to-world mapping cannot succeed. The difference between semantic bootstrapping and syntactic bootstrapping, then, is that the former procedure deduces the structures from the word meanings that are antecedently acquired from real-world observation; while the latter procedure deduces the word meanings from the semantically relevant syntactic structures associated with a verb in input utterances.

Let us take the simple examples of put, look, and see., which occurred in the corpus provided by the blind child's mother. Verbs that describe externally caused transfer or change of possessor of an object from place to place (or from person to person) fit naturally into sentences with three noun-phrases, e.g. John put the ball on the table. This is just the kind of transparent syntax/semantic relation that every known language seems to embody and therefore may not be too wild to conjecture as part of the original presuppositional structure that children bring into the language learning task (Jackendoff, 1978; 1983; Talmy, 1975; Pinker, 1984). That is, 'putting' logically implies one who puts, a thing put, and a place into which it is put; a noun-phrase is assigned to each of the participants in such an event. In contrast, since one can't move objects from place to place by the perceptual act of looking at them, the occasion for using look in such a structure hardly, if ever, arises (John looked the ball on the table sounds unnatural). Hence the chances that /put/ means 'put' are raised and the chances that /put/ means 'look' are lowered by the fact that the former and not the latter verb appears in three-noun-phrase constructions in caretaker speech (see Table 2).[10]

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[10] The exceptions are (1) if you believe in psychokinesis or (2) if the rules of some game make it so that, in effect, an external agent can cause an object to move by looking at it, e.g., The shortstop looked the runner back to second base. In effect, once look does mean cause-to-move-by-perceptually-exploring, it becomes comfortable in this construction. Of course these simple examples vastly underestimate the detail required if such a theory is to become viable. One such

	Near	Far	No object	"Near" proportion
Canonical sentence frames and deictic uses				
Look at NP	3	0	0	
Look D	2	0	0	1.00
Look!	8	0	0	
Look! this is NP	10	0	0	
See NP	1	2	0	
See?	1	0	0	.72
See?, This is NP	3	0	0	
With motion auxiliaries				
Come see NP	0	3	0	.00
Other environments				
Look AP	0	1	1	
Look like NP	0	0	5	.18
Look how$_{rel}$	0	2	0	
Look ø	2	0	0	
See S	2	3	0	.25
See ø	0	2	1	
Total (all environments)				
Look	25	3	6	.73
See	7	10	1	.39

Table 3: Situational contexts for the common verbs used by the blind child's mother, organized according to the syntactic (subcategorization frame) contexts (from Landau and Gleitman, 1985)

Verbs of perception and cognition are associated with some other constructions, as they should be. For example, if a verb is to mean 'see' (perceive perceptually), it should appear with noun-phrase objects as in John saw a mouse, for noun-phrases are the categories that languages select to describe such entities as mice. But since events as well as entities can be perceived, this verb should also appear with sentence complements, since clauses are the categories selected by languages for expressing whole events (e.g., Let's see if there's cheese in the refrigerator). The possibility that /see/ means 'see' is increased by appearance in this construction, and the likelihood that /put/ means 'see' is decreased by the fact that one hardly, if ever, hears Let's put if there's cheese in the refrigerator; see again Table 2).

Speaking more generally, certain abstract semantic elements such as 'cause,' 'transfer,' and 'cognition' are carried on clause structures (subcategorization frames) rather than (or in addition to) as item-specific information in the lexical entries of verbs. These semantically relevant clause structures will be chosen for utterance only to the extent that they fit with the overall meanings of the verb items. It follows that the subcategorization frames, if their semantic values are known, can convey important semantic information to the verb learner. To be sure, the number of such clause structures is quite small compared to the number of possible verb meanings: It is reasonable to assume that only a limited number of highly general semantic categories and functions are exhibited in the organization that yields the subcategorization frame distinctions. But each verb is associated with several of these structures. Each such structure narrows down the choice of interpretations for the verb. Thus these limited parameters of structural variation, operating jointly, can predict the possible meaning of an individual verb quite closely. Landau and Gleitman showed that the child's situational and syntactic input, as represented in Tables 2 and 3, were sufficient in principle to distinguish among all the verbs commonly used in the maternal sample for the blind child. This general outcome is schematized in Figure 3.

The potential virtues of this syntactically informed verb-

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problem is that the child must impose the proper parse on the sentence heard, lest John saw the book on the table be taken as a counter-example (that is, the analysis is to be of sister-nodes under VP only, and a theory of how the child determines such configurations antecedently is a requirement of the position). Another real difficulty is that the child might run into one of many quirky constructions like John saw his brother out of the room, looked his uncle in the eye, etc.

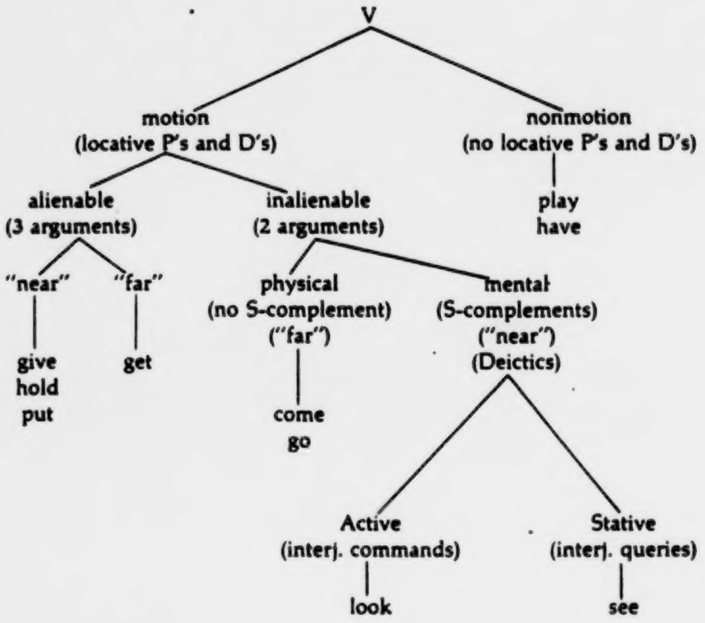
V
motion
(locative P's and D's)
nonmotion
(no locative P's and D's)
alienable
(3 arguments)
inalienable
(2 arguments)
play
have
"near"
"far"
physical
(no S-complement)
("far")
mental
(S-complements)
("near")
(Deictics)
give
hold
put
get
come
go
Active
(interj. commands)
Stative
(interj. queries)
look
see

Figure 3: Summary of the situational and syntactic distinctions among verbs commonly used by the mother to the blind child during the learning period. (from Landau and Gleitman, 1985)

learning procedure are considerable. First, it serves the local purpose of offering a non-magical explanation for the blind child's acquisition of visual terms, as just described. Second, it points the way toward acquisition of terms when observation fails. This is because, for example, mental verbs such as think are unambiguously marked by the syntax (by taking sentence complements) even though their instances cannot be readily observed in the world. Third, it gives the child a way of learning from a very small database. This is because the number of subcategorization frames associated with each verb is small (on the order of 10 - 20), and these are the data requirements for the procedure to work. Fourth, that database is categorical rather than probabalistic: Though verb uses to the child are often pertinent to what is going on in the here-and-now, sometimes they are not (e.g., the mother may speak of running to the store while she sits in her parlor). In contrast, mothers virtually never speak ungrammatically to their children -- that is, use verbs in nonlicensed syntactic environments (Newport, 1977). Thus the child can take one or two instances of a verb in some frame as conclusive evidence that it is licensed in this environment. Finally, what is used in this procedure for learning is part of what must be known by an accomplished speaker: Knowing the subcategorization privileges for each verb is part of what it means to be an English speaker. In contrast, many of the situational analyses constructed along the way by the semantic bootstrapper will not figure in the final definition of a verb.

In the light of all these virtues, it would be nice if this theory turned out to be part of the truth about how the verb vocabulary is acquired. I will provide some empirical evidence in its favor below. But first some presuppositions of the position have to be defended before so apparently "abstract" a procedure can be considered viable at all. I turn now to such questions.

Prolegomena to the bootstrapping hypotheses

The bootstrapping hypotheses involve a number of presuppositions that require demonstration in their own right, lest all learning questions be begged. In company with all known theories of word learning, they presuppose that the human child, by natural disposition (or learning during the prelinguistic period) is able to conceive of such notions as 'running' and 'looking' and implicitly understands that words make reference to such acts and events. Past this background supposition, both semantic and syntactic bootstrapping procedures -- but especially the latter -- make very strong claims about the child's knowledge as verb learning begins. I will now go through these claims, mentioning some of the experimental evidence that gives them plausibility.

Are the rules linking semantics and syntax strong and stable enough to support a learning procedure? If the syntactic structures associated with verbs are uncorrelated with -- or hardly correlated with -- their meanings, then the child can't learn much about the meanings by observing the structures. No one doubts the sheer existence of such form/meaning regularities owing to the results achieved by a generation of linguists, notably Gruber, Fillmore, Vendler, Jackendoff, and Levin (and many others), but questions can be raised about the stability, degree, and scope of these relations. That is, how far can a syntactic analysis such as that in Table 2 succeed in partitioning the lexicon semantically for the child learner?

I'll mention one line of investigation of these questions from our laboratory. Fisher, Gleitman, and Gleitman (in press) reasoned as follows: If similarity in the range of subcategorization frames of verbs is correlated with similarities in their meanings, then subjects asked to partition a set of verbs (a) according to their meanings and (b) according to their licensed structures should partition the verbs in much the same ways. To test this idea, one group of subjects made judgments of meaning-similarity for triads of verbs presented to them. Specifically, they chose the semantic outlier in each triad (e.g., shown eat, drink, and sing, they choose sing as the outlier, but shown eat, drink, and quaff they might choose eat). A semantic space for a set of verbs was derived from these data by tabulating how often two verbs stayed together (were not chosen as outlier) in the context of all other verbs with which they were compared. Presumably, the more often they stayed together, the more semantically similar they were. A second group of subjects gave judgments of grammaticality for all these same verbs in a large number of subcategorization frames. A syntactic space was derived in terms of the frame overlap among them. The similarity in the syntactic and semantic spaces provided by these two groups of subjects was then compared statistically.

The finding was that the frame overlap among the verbs is a very powerful predictor of the semantic partitioning. In short, verbs that behaved alike syntactically were, to a very interesting degree, the verbs that behaved alike semantically. Such results begin to show that a syntactic partitioning of the input can provide important evidence for a learner who is disposed to use such information -- as was conjectured for the blind child, see Figure 3.

Are the semantic/syntactic relations the same cross-linguistically? The first proviso to the conclusion just drawn, for learning questions, is that the semantic-syntactic relations have to be about the same across languages. Otherwise, depending on the exposure language, different children would have to perform different syntactic analyses to derive aspects of the meaning. And that, surely, begs the questions at issue.

Recent theorizing in linguistics does support the idea that there are semantic/syntactic linkages that hold across languages. In a recent version of generative grammar (Government/-Binding theory; see Chomsky, 1981), some of these relationships are stated as universal principles of language design. One example is the mapping of entities implied by the verb logic one-to-one onto noun-phrase positions in the clause: Every NP in a sentence must receive one and only one thematic role (the theta-criteri- on). Moreover, a related principle (the projection principle) states that the theta-criterion will hold at every level of a derivation; in particular, that argument structure is preserved on the surface clause structures. This is just the organization required by a bootstrapper -- semantic or syntactic.

Talmy (1975; 1985) has investigated a number of typologically quite different languages and found a variety of striking similarities in how their semantics maps onto the syntax. For those who prefer experimental evidence from linguistically naive subjects, Fisher et al, in a very preliminary cross-linguistic foray with their method, showed that the relationship between being a verb of cognition and accepting sentence complements is as strong and stable in Italian as in English.

The two relationships just mentioned (that a NP is assigned to each participant in the event, and that verbs encoding the relation between an agent and a propositon accept sentence complements) are not only true cross-linguistically. They have a kind of cognitive transparency that makes them plausible as part of the presuppositional structure children might really bring into the language learning situation. As Jackendoff puts this point:

> In order to lighten the language learner's load further, it seems promising to seek a theory of semantics (that is, of conceptualization) in which the projection rules are relatively simple, for then the child can draw relatively straightforward connections between the language he hears and his conception of the world. The methodological assumptions for such a theory would be that syntactic simplicity ideally corresponds to conceptual simplicity; grammatical parallelisms may be cluses to perceptual parallelisms; apparent grammatical constraints may reflect conceptual constraints.
>
> (1978; p. 203)

From these and related arguments and demonstrations, I think the plausibilty of the bootstrapping theories receives at least some initial defense.

Can the learner analyze the sound wave in a way that will support discovery of syntactic structure? There is a timing difference in the requirements of semantic and syntactic bootstrapping approaches: For the latter approach, the learner has to be able to parse the sentences that she hears in order to derive a syntactic analysis; moreover, at least some of the mapping rules have to be in place before the verb meanings are known and thus the whole game is over. There is strong evidence supporting both these claims:

Can infants parse?: Once upon a time, not so very long ago, it was believed that babies could divide up the sound wave into words but not into phrases. This perspective necessitated complex theories for how learners could derive phrasal categories from the initial word-like representations (Wexler and Culicover, 1980; Pinker, 1984). In retrospect, these ideas were somewhat improbable. For one thing, there is evidence that infants are sensitive to such physical properties of the wave form as change in fundamental frequency, silent intervals, and syllabic length, all of which are universal markers of phrase boundaries (see, e.g., Fernald, 1984). As Gleitman and Wanner (1982) pointed out, the physical correlates of word segmentation are far more subtle and less reliable. More generally, our reading of the cross-linguistic facts about language learning led us to propose that the infant's analysis of the wave form was as a rudimentary phrase-structure tree.[11] In a similar vein, Morgan and Newport (1981; Morgan, Meier, and Newport, 1988, showed in a series of artificial language-learning experiments that adults could learn phrase structure grammars if provided with phrase-bracketing information but not if provided only with word-level information. This finding led these investigators independently to the same proposal about the child's initial representation of the input wave forms. Recently, Hirsh-Pasek and her colleagues (1988a) have shown that prelinguistic infants listen to maternal speech doctored so as to preserve phrase- and clause-bounding information in preference to speech doctored so as to remove or becloud this information (see Gleitman et al, 1987, for a review of the evidence and its interpretation for a language acquisition theory).

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[11] Notoriously, word-segmentation in a language like English is so fraught with ambiguity that new pronunciations (e.g., nother and apron replacing other and napron) are quite common. Moreover, there are long-lasting errors by children, e.g., one six-year old wrote "The teacher said, Class be smissed!" The phrasal parses suggested by Gleitman and Wanner were "rudimentary" to the extent that the unstressed elements in the phrases were presumed to be less well analyzed than the stressed elements, and the phrases were unlabelled (but see Joshi and Levy, 1982, for evidence that much of labelling, or its equivalent, can be derived from "skeletal" representations in which there are configurations but no overt labels).

The evidence just cited is not precise enough to give a detailed picture of the infant's phrasal parse[12] However, that evidence is strong enough to support the view that children, even in the prelinguistic period, impose an analysis on the wave form sufficient for partitioning it into phrases. There is weaker but still suggestive evidence that the young learners also have the wherewithal to label the phrases differentially (see again footnote 11). It is incontrovertible that the two and three year olds who are the real verb learners can achieve the analyses of input shown in Table 2, and which are a requirement for achieving the semantic partitioning of the verb set shown in Figure 3.

Does the learner know the syntactic/semantic correspondance rules? A crucial further requirement for the bootstrapping hypotheses is that the child understand the semantic values of the subcategorization frames. A child who recovers the meaning from observation, and who is to deduce the structures therefrom, has to know what the semantics of the verb implies about the syntactic structures licensed. And a child who recovers the syntactic structures licensed for verbs from the linguistic contexts in which she hears them has to know what semantic elements are implied by participation in these structures. As Jackendoff emphasized, the burden of learning would certainly be reduced for a child in possession of such information. But do real learners actually have it? There is striking evidence that they do.

Golinkoff et al (1987) developed a very useful paradigm for studying very young children's comprehension. Essentially, they adapted a procedure designed by Spelke for studying infant perception. The set-up for the language case is shown in Figure 4. The child sees different scenes displayed on two video screens, one to the child's left, one to her right. The scenes are accompanied by some speech stimulus. The mother wears a visor so that she cannot observe the videos and so cannot give hints to her child. Hidden observers are so positioned that they cannot observe the video, but they can observe which way the child is looking, and for how long. It turns out that children look sooner and longer at the video that matches the speech input.

In a first demonstration relevant to the syntactic bootstrapping hypothesis, Golinkoff et al showed that 19-month old children -- many of whom had never put two words together in an utterance, and knew few if any verbs -- understand some facts about the semantic values of English constructions. Two simultaneous videos showed cartoon characters known to the children interacting. For some subjects, the stimulus sentence was Big Bird is tickling Cookie Monster. For the others, it was Cookie Monster is tickling Big Bird. The children demonstrated by their selective looking that they knew which sentence described which observed event: They looked longer at the screen showing Big Bird tickling Cookie Monster when they heard the former sentence, and at the screen showing Cookie Monster tickling Big Bird when they heard the latter sentence. That is, these children recognize the order of phrases (or something approximating phrases) within the heard sentence and also understand the semantic significance of the ordering for the propositional interpretation of English speech (see also Slobin and Bever, 1982, for cross-linguistic evidence on this topic).

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[12] But see Eccles and Newport, forthcoming, for experimental findings that support significant theorizing in this area.

I and my colleagues (Hirsh-Pasek et. al, 1988b) used this same procedure to investigate one more property of the mapping rules, namely the causative structure for which Bowerman (1982) had found many innovative uses by youngsters: Roughly, intransitive motion verbs (e.g., Big Bird turns) can be "transitivized" in English and then will express the causal agent as well (Cookie Monster turns Big Bird).

To study this question using the procedure of selective looking, it is necessary that both entities appear in the stimulus sentence; otherwise the children may use the relatively trivial strategy of looking at the stimulus showing Big Bird if and only if Big Bird is mentioned. Hence the real stimuli used were, for example, Big Bird is turning Cookie Monster and Big Bird is turning with Cookie Monster. One video showed the two characters turning side by side, and the other video showed one character physically causing the other to turn. In addition to verbs like turn that (by maternal report) were probably known to the 2-year old subjects, unknown ones were also used. For example, the characters were shown flexing their arms, or one flexing the arms of the other, along with the stimuli Big Bird is gorping Cookie Monster and Big Bird is gorping with Cookie Monster. We were unable to show stable effects of the syntactic structure for children at 24 months of age. But just about every youngster by 27 months showed the effect of the structure, by looking longest at the syntactically congruent screen.

The conclusions to be drawn are very important ones for the syntactic bootstrapping hypothesis. The paired actions are the same, e.g., both are of turning in a circle, or both are of flexing the arms. What differs is whether a causal agent of that action is also present in that scene. The children seem to know that only the transitive use of the verb can be expressing that cause. More strongly, that causal agent cannot be in an oblique argument position (the with phrase).

Prior demonstrations of knowledge of mapping rules have generally been with much older children. For instance, Bowerman notes that most spontaneous overgeneralizations of the causative structure ("Don't eat the baby!") are later, in the three to five-year old period.[13] Pinker and his colleagues have offered many compelling demonstrations of a variety of mapping rules, but again mainly with three to five year olds. These findings give general support to the idea that learners recruit the semantic/syntactic correlations somewhere during the course of learning. But the early appearance of these skills is crucial as support for the notion that the child has the mapping rules under control early enough for them to contribute to the acquisition of the verb meanings themselves.

Using syntax to acquire verb meanings

So far I've tried to show that a number of presuppositions of syntactic bootstrapping are reasonable: The language does exhibit strong and stable syntactic/semantic correlations, and these powerfully predict adult classificatory behavior; children in the prelinguistic period can and do parse sentences to recover the analyses required for extracting subcategorization frame information; such phrasal information is a requirement for language learning, at least for adults in the artificial language-learning laboratory; children at a very young age and language-learning stage understand the semantic values of at least some syntactic frames.

All of these findings were prolegomena to the syntactic bootstrapping approach. They were adduced because it is bad enough that this approach seems so unnatural and formal a one for a child to choose; it would be worse if the child couldn't come up with the analyses that the position presupposes. But now that I've presented at least some preliminary support that children can meet these prior requirements, the question remains: Do they use syntactic evidence to decide on the meaning of a new word?

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[13] But see also Naigles, Gleitman, and Gleitman (in press) for a demonstration that two year olds understand the significance of new motion transitives, even though they may not be brave enough to invent any until they are three. The subjects here were asked to "act out" scenes using a Noah's Ark and its animal inhabitants. For instance, the child might be told to act out "Noah brings the elephant to the ark." But some of the stimuli were more unusual, e.g., "Noah comes the elephant to the ark" or "The elephant brings to the ark." The children by their acting-out performances showed that they thought transitive come means 'bring' and that intransitive bring means come.

The first, and justly famous, work on this topic was done by Roger Brown (1957). He showed three to five year olds a picture in which, say, spaghetti-like stuff was being poured into a vessel. Some subjects were asked to show some gorp, others a gorp, and still others gorping. The subjects' choices were, respectively, the spaghetti, the vessel, and the action. Evidently, the semantic core of the word classes affects the conjecture about the aspect of the scene in view that is being labelled linguistically.

Brown's result, though alluded to respectfully, just sat there for twenty years or so because in this respect as in many others Brown was a theorist ahead of his time. Eventually, MacNamara took up and advanced these ideas: In his important 1972 paper, he argued forcefully for the place of language structure in language acquisition. Experimentally, Baker, Katz, and MacNamara (1974) showed that children as young as 19 months used the structure in which new nouns appeared (a gorp vs Gorp) to decide whether a new word encoded a class or an individual (i.e., a doll of the gorpy type, or some doll named Gorp). Thus the lexical category assignments of words were shown to carry semantic implications, and these were evidently recruited by learners.

Naigles (in press), working in my lab and also in the lab of Hirsh-Pasek and Golinkoff at Temple University, extended this kind of demonstration to the case of verb learning (that is, to the usefulness of syntax for drawing semantic inferences within a single lexical category), thus giving the first direct demonstration of syntactic bootstrapping at work.

Twenty-four month olds were again put into the selective looking situation. This time, however, their task was to decide between two utterly disjoint interpretations of a new verb. In the training (learning) period, they saw a single screen, and the following mad event: A rabbit is pushing a duck down into a squatting position with his left arm (these were people dressed up as rabbits and ducks so they did have arms). The duck pops up, and the rabbit pushes him down again, etc. Simultanously, both rabbit and duck are making big circles in the air with their right arms. Some children heard a voice say The rabbit is gorping the duck and other children heard The rabbit and the duck are gorping as they watched this scene.

Succeeding the observation, the screen goes dark and the voice is heard to say something syntactically uninformative, e.g. Oh, there's gorping; now there's gorping! Now new videos appear on two screens, as shown in Figure 4. On one screen, the rabbit is pushing the duck down (but with no arm-wheeling). On the other screen, rabbit and duck are wheeling their arms (but with no squatting or forcing to squat). The child's looking time at the screens, as a function of his syntactic

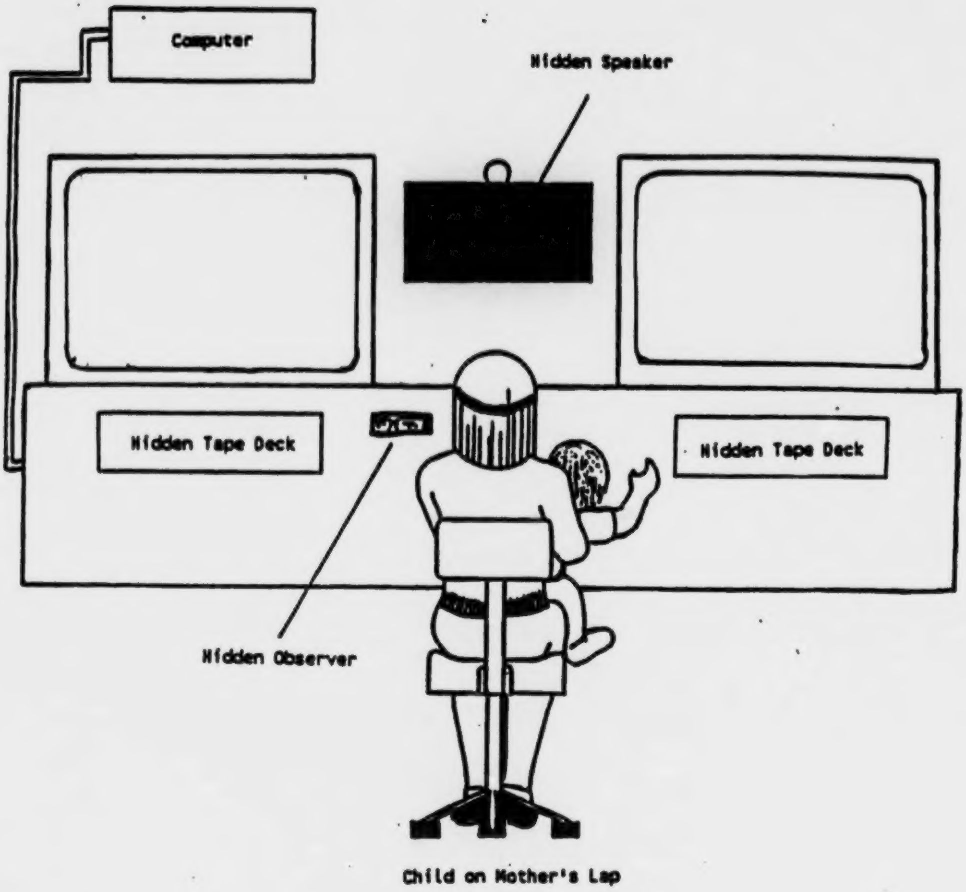
Computer
Hidden Speaker
Hidden Tape Deck
Hidden Tape Deck
Hidden Observer
Child on Mother's Lap

Figure 4: Set-up for the selective looking experiments (from Naigles, in press)

introducing circumstances, is now recorded (double-blind as usual, i.e., neither the mother nor the experimenters know which screen the child saw during the training period).

Naigles' result was that virtually every 24-month old tested -- and there were many, this being a Ph.D. thesis--showed the effect of the syntactic introducing circumstance. Those who heard the transitive sentence apparently concluded that gorp means 'force-to-squat.' Those who heard the intransitive sentence concluded that gorp means 'wheel the arms.'[14]

What shall we conclude from this experiment? Clearly the child uses the event-context in some way to license conjectures about a verb meaning. But in this case, "The Main Event" is ambiguous not only in principle but in fact. Under these trying circumstances, at least, the learner attends to the information potential of the semantically relevant syntactic evidence.

A question of scope

So far the experiments I've mentioned have lingered nernervously around a few constructions, e.g. the lexical causative in English which is a notorious focus of syntactic extension by adults as well as children. Even if it is accepted that children sometimes do use syntactic evidence to bolster their semantic conjectures, how broad can the scope of such a procedure be? Maybe its role is just to clean up a few little details that are hard to gleen from the world -- just backwards semantic bootstrapping, as Pinker has sometimes put the matter.

The relative roles of linguistic and extralinguistic observation as the source of word-meaning acquisition is not within calling distance of settlement, of course. But the burgeoning linguistic and psycholinguistic literature on lexical semantics suggests that the semantic/syntactic linkages may be quite pervasive and stable, and play a potent role in organizing the verb lexicon.

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[14] Notice that in all the selective looking experiments I've mentioned all the participants are animate so there's no room for counter-interpretations such as the strategy of assigning the animate entity to the subject position. Note also that in the present experiment the intransitive sentence contained a conjoined nominal (The duck and the rabbit) and this might be seen as a defect: Maybe the child knows the difference beteen a preverbal and a postverbal nominal rather than the difference between a transitive and an intransitive structure. This interpretation is effectively excluded by the version presented earlier (Hirsh-Pasek et al, 1988b) in which the two noun-phrases appear in different argument positions, one serially before and one after the verb (Big Bird is turning with Cookie Monster). For elegance, however, it certainly would be nice to redo the present experiment with the stimulus type used in the former one.

Fisher, Hall, Rakowitz, and I have just completed some studies designed to investigate the scope of children's exploitation of the syntactic environment in learning new verb meanings. I believe that our prior studies with children two years old and younger yield evidence that satisfies an explanatory demand of this approach: The bootstrapping procedure has to be able to operate very early in the child's linguistic life, else it hardly explains how verbs are acquired.

Nevertheless, the selective looking paradigm (which is one of very few that work with toddlers) is too much of a straight-jacket to be the only vehicle for extensive investigation of this approach. It is tedious in the extreme to set up (requiring the preparation of movies, etc.), takes hoards of infants to carry out (for some scream or sleep or worse and have to be removed from the premises; and only a few trials can be presented even to the more docile infants), and yields probabilistic results (in part because the subjects are not notified directly of the task they are to perform). Moreover, it may very well be that the child's knowledge of the linking rules expands as his language knowledge grows, creating more latitude within which he can learn new meanings from linguistic evidence (After all, in the end we can do it by looking in the dictionary).

We therefore set out to see whether preschoolers (aged 3 and 4 in the version now presented) would give us meanings in response to linguistic/situational stimuli upon request. The idea derived from a manipulation attempted by Marantz (1982). He had asked whether children are as quick to learn noncanonical vs noncanonical mappings of semantics onto syntax. He introduced children to novel verbs as they watched a movie. For instance, one movie showed a man pounding on a book with his elbow. Marantz' question was whether children were as quick to learn that The book is moaking Larry (the noncanonical mapping) was a way of describing this scene as that Larry is moaking the book (the canonical mapping) was a way of describing the scene.

Although the manipulation was an interesting one, unfortunately Marantz never asked the children how they interpreted the scene, so his results are not really relevant to understanding the child's perception of syntactic/semantic correlations. That is, Maranz presupposed that a scene viewed has only a single interpretation, an idea I have strenuously opposed throughout this discussion. My colleagues and I revised this experiment, changing the measure so we could find out about the child's comprehension in these circumstances. In essence, we asked how the nonsense word is interpreted within differing linguistic environments. As a first step, we showed the moaking scene (in which Larry pounds the ball with his elbow) to adults. If we said "This scene can be described as a "moaking scene" and then asked them what moak meant, they said "pounding." And if instead we showed them the scene and said "This is Larry moaking the book," they still asserted that moak means "pound." But when we showed them the scene and said "This is the book moaking Larry," they answered that moak means "hurt" or "resist."

This suggests that adults make use of the fact that particular surface syntactic structures are associated with particular semantic values. They seem to bootstrap the meaning from examination of the scene taken together with its syntactic expression, just as the syntactic bootstrapping procedure claims. To be sure, the contextless presentation of moak with this scene irresistably yields the concept 'pound' as its interpretation. So there's much to be said for the idea of "salience" in the interpretation of events (though, to be sure, no one knows what exactly). But the important point is that there is a categorical shift in interpretation of the same scene -- to a less salient, but still possible, interpretation -- in response to its linguistic setting; namely 'pound' if Larry is in the subject position, but 'hurt' if the book is in that position.

Fisher et al now adapted this procedure for children. We took advantage of the idea, popularized by such Penn developmentalists as Gelman, Waxman, Macario, and Massey, that preschoolers will do just about anything to help out a puppet. We introduced a puppet saying "This puppet sometimes talks puppet-talk so I can't understand him; can you help figure out what he means?" The children were happy to oblige. They were shown videotaped scenes in which animals were performing certain acts. For example, a rabbit appeared, looked to the left, and then ran rapidly off the screen toward the right; directly behind him ran a skunk, also disappearing at the right. Then the child would hear either "The rabbit is gorping the skunk" or else "The skunk is gorping the rabbit."

The structures investigated are shown in Table 4. They are designed to ask whether the child is sensitive to the number of argument positions (stimuli 1 and 2), the structural positions of agent and patient (stimuli 3 and 4), and the structural positions taken together with prepositional markers of the oblique roles (stimuli 5 and 6). Thus we now began to investigate the scope of the structural/semantic linkages to which learners may be sensitive. Notice that the pairs chosen are just the kind that I have discussed throughout: The same scenes, multiply interpretable, are shown but accompanied by a novel verb used in varying constructions.

SCENE	STIMULUS SENTENCE
1. a) Rabbit eating.	The rabbit moaks.
b) Elephant feeding rabbit	The elephant moaks the rabbit.
2. a) Monkey pushing elephant.	The monkey pumes the elephant.
b) Elephant falling	The elephant pumes.
3. a) Monkey riding elephant.	The monkey gorms the elephant.
b) Elephant carrying monkey.	The elephant gorms the monkey.
4. a) Rabbit fleeing skunk.	The rabbit zarps the skunk.
b) Skunk chasing rabbit.	The skunk zarps the rabbit.
5. a) Rabbit giving a ball to elephant.	The rabbit ziffs a ball to the elephant.
b) Elephant taking a ball from rabbit.	The elephant ziffs a ball from the rabbit.
6. a) Skunk putting blanket on monkey.	The skunk is biffing a blanket on the monkey.
b) Skunk covering monkey with a blanket	The skunk is biffing the the monkey with a blanket.

Table 4: Stimuli used by Fisher, Hall, Rakowitz, and Gleitman (forthcoming). All Ss were exposed to the same six scenes (each scene has two plausible interpretations, called a) and b) in the left-hand column. Along with these scenes, half the children heard a) stimulus sentences and half heard b) stimulus sentences (with appropriate counterbalancing across Ss and stimuli).

The findings are shown in Table 5. They are presented in terms of the likelihood of various responses depending on the introducing syntactic structure. For example, the response give (response A) to structure (a) in Table 4 (The rabbit ziffs a ball to the elephant) was made by 4 Ss, but the response take (or, equivalently, get) was made by only 2 Ss in this condition. Symmetrically, the response take or get (response B) was made by 5 Ss in response to structure (b) in Table 4 (The elephant ziffs a ball from the rabbit), while that response was never made to structure (a).

Overall, 71 relevant responses made by these children were congruent with the semantic value implied by the syntactic structure, while only 13 relevant responses were inconsistent with the structural information. Moreover, for each scene and for each syntactic type, the number of syntactically congruent responses is greater than the noncongruent responses. The level of congruence was about the same for all three semantic/syntactic relations studied: 83% congruent responses when the variable was number of noun-phrases, 89% congruent responses when the variable was structural position of these noun-phrases, and 81% congruent responses when the variable was position plus prepositional marking.

One might object that these children are "merely" paraphrasing verbs that they previously know to occur in these syntactic environments. That is true, but it does not take away seriously from our interpretation of these findings: The children knew, evidently, that the appropriate paraphrase had to be one which fit both with the scene and with the sentence structure heard. This is the reverse of Pinker's claim that the verb meanings must be acquired by extralinguistic observation in advance of, and as the basis for, deducing their appropriate syntactic structures. But the results are exactly those expected in the syntactic bootstrapping approach.

A note on the input corpus

One of several holes in our present evidence has to do with the characteristics of caretaker speech. I have presented a single example corpus (Table 2) tending to support the idea that caretaker speech is rich enough to yield quite a full range of structures to support the syntactic bootstrapping procedure. And this corpus was for a mother speaking to a blind child, whose word-learning situation may be quite special. We are now analyzing an extensive corpus of mother/child speech in a naturalistic setting (originally collected by Landau and Gleitman) to see whether children characteristically receive the range of structures adequate to support a realistic syntax-based procedure (Lederer, Gleitman, and Gleitman, 1989). So far, the prospects from this larger database look good. Lederer finds

Syntactic type of the stimulus		Response A		Response B	
a	b	S_a	S_b	Sb	S_a
eat	feed	7	1	6	1
push	fall	8	3	4	0
ride	carry	7	2	4	0
flee	chase	6	0	8	1
give	take	4	2	5	0
put	cover	8	3	4	0
TOTALS:		40	11	31	2

Table 5: 16 Ss (aged 3-4) asked: WHAT DOES BIFFING MEAN? Not all subjects answered every question, accounting for totals in each row not totalling to 16. Also, some responses were irrelevant to either interpretation of a stimulus, e.g., S might say in response to the flee/chase scene "They're having fun!" These irrelevant stimuli are excluded from this tabulation.

that each of the 24 verbs most often used by these mothers to their children has a distinctive syntactic distribution. When the usages are pooled across mothers, these distinctions are preserved.

The next question is whether these syntactic distributions map onto a semantic space coherently. An independent assessment of the semantic relations among these verbs is required as the evidence. Lederer therefore is now testing this issue by using these verbs in the kind of manipulation employed by Fisher et al; namely, asking adult subjects for judgments of the semantic outlier in all triads of these verbs. Preliminary inspection of the verbs suggests that the semantic clusters that emerge from these data are strongly predicted by the syntactic overlaps in the maternal corpora.

Conclusions

I began discussion by acknowledging the intuitive power of Locke's view that words are learned by noticing the real-world contingencies for their use. Then I tried to show that such a word-to-world mapping, unaided, was in principle insufficiently constrained to answer to the question of how the child matches the verbs (qua phonological objects) with their meanings. The solution that I and my colleagues have offered was that semantically relevant information in the syntactic structures could rescue observational learning from the sundry experiential pitfalls that threaten it. This theory, of course, is the very opposite of intuitive. But when probable solutions fail, less probable ones deserve to be considered. I therefore sketched a rather wide-ranging empirical review that we have undertaken to see whether, after all, children might not be deducing some of the meanings from their knowledge of structural/semantic relations. I believe that the evidence we now have in hand materially strengthens the plausibility of the viewpoint.

Still, the conclusions that can be drawn currently about the generality and pervasiveness of syntactic bootstrapping must be exceedingly tentative, on a variety of grounds. Some of these I have discussed: No one has more than a glimmer of an idea about just how the verb lexicon is organized, and therefore we don't really know how much information about semantics can be gleaned from that organization. Also, we have at present only the most meager data concerning the orderliness and richness of the child's syntactic input. Facts about the cross-linguistic similarities in the syntax/semantics correspondances are also extremely fragmentary, currently.

There are in addition numerous problems with the analyses performed that I have altogether skirted so far. For example, it is not an easy task to decide which structures co-occurring with verbs should actually be considered part of the frame specifications, and which are merely adjuncts. To construct Table 2 (and in Lederer's ongoing work) we had to make some choices, but some of them may be wrong. And if we had these problems in assigning structural descriptions to the mother's utterances, isn't the learner similarly beset?[15] Another huge problem is the "idiomatic" verb uses that I mentioned in passing (footnote 10), e.g., John saw his victim out of the room, looked his enemies in the eye, etc. It may be significant that these monstrosities are just about totally absent from the maternal corpora we have examined, but absence in fact (rather than in principle) is a pretty weak reed on which to build so strong a position as the one I've tried to defend.

The largest problem of all is how learners acquire the semantic/syntactic linking rules in the first place. Bowerman's evidence, and all the findings I've just discussed, are understandable only (so far as I can see) by asserting that learners are in possession of such linking rules. But where did they come from? In the present discussion, I've subscribed to a version of Jackendoff's hypothesis that the linking rules are somehow cognitively transparent to the child. But since there is at least some cross-linguistic variance in such syntactic/semantic regularities (see Talmy, 1985), I admit that I'd be happier to find that they could be derived from some more primitive categories or functions. The problems here cry out for serious investigation.

In light of the various issues just mentioned, one must remain agnostic about the bootstrapping proposals, at present. But I hope I've persuaded you that the prospects they open for explanation of the verb-learning feat are enticing enough to make continued investigation seem worthwhile.

It remains to point out that, by their nature, both semantic and syntactic bootstrapping are perilous and errorful procedures and their explanatory power must be evaluated with this additional proviso in mind. Bowerman's children, drawing syntactic conclusions from meaningful overlap, are sometimes wrong. Errors are made insofar as the scenes are multiply interpretable; for instance, youngsters often interchange win and *beat*, presumably because these occur in exactly the same circumstances. But syntactic bootstrapping is no more free of potential error. This is because the form-to-meaning mapping in the exposure language is complex and often inexact. For instance, *exit, enter, reach* and *touch* differ from most verbs describing directed motion through space in not requiring prepositional phrases to express the motion paths (compare *come into the room* but *enter the room*). One outcome of this inexact mapping of form onto meaning is errorful learning (e.g., the child may say "I touched on your arm") and its end point, language change (e.g., while *exit the stage* was the more common in Shakespeare's time, *exit from the stage* is now on the ascendancy). Short of changing the language, how do learners recover from such errors?

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[15] There is some evidence in the literature of adult speech perception that adjunct and argument phrases may be intonationally distinguishable (see Gleitman and Wanner, 1982, for a review; and Carlson and Tannenhaus, 1988, for some experimental evidence). These distinctions, if real, can be expected to be exaggerated in maternal speech. Nevertheless, the issues here are quite complex and have not been thoroughly studied by any means. And they do bear in serious ways on the amount of work that syntax can be expected to do for the verb learner.

The position I have been urging is that children ferret out the forms and the meanings of the language just because they can play off these two imperfect and insufficient databases (the saliently interpreted events, and the syntactically interpreted utterances) against each other to derive the best fit between them. Neither syntactic nor semantic bootstrapping work all the time, nor taken together do they answer to all the questions about how children acquire their verb vocabulary. But I hope I've convinced you that each of these procedures works very well indeed when it does work, so the wise child should, and probably does, make use of both of them.

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ACQUISITION OF NOUN INCORPORATION IN INUKTITUT*

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1. Introduction

This paper investigates the first language acquisition of productive noun incorporation in Inuktitut. It begins with descriptions of noun incorporation, relevant aspects of the structure of Inuktitut, and working criteria of productivity in sections 2, 3 and 4. It then presents acquisition data from Inuktitut in section 5 and corroborating data from West Greenlandic in section 6, and contrasts both of these with acquisition data from Mohawk in section 7. Finally, several explanations for the seemingly early acquisition of noun incorporation in Inuktitut are hypothesized in section 8.

2. Noun Incorporation

Noun incorporation (henceforth, NI) is a structure which appears in a large variety of genetically and typologically diverse languages. In NI, a particular noun root from the sentence appears inside the verb form rather than as an independent lexical item. The two roots appear to work together as a unit for purposes of agreement marking, case assignment, and other relevant processes. It is standardly assumed in a variety of frameworks that both Inuktitut and Mohawk evidence noun incorporation (Baker 1988; Mithun 1984; Rischel 1971; Sadock 1980, 1986).

(1) a. Palasi-p **niqi**-Ø niri-vaa.
minister-ERGsg meat-ABSsg
eat-3sS/3sO.INDIC
'The minister eats/ate the meat.'

b. Palasi-Ø **niqi**-tur-puq.
minister-ABSsg **meat**-eat-3sS.INDIC
'The minister eats/ate meat.'
(Greenlandic; Rischel (1971))

(2) a. Wa?kyvtho? o**ji:ja**?.
wa?-k-yvtho? o-**ji:ja**-?
AOR-1sS-plant PRE-**flower**-SUF
'I planted a flower.'

b. Wa?k**ji?ja**yvtho?.
wa?-k-**ji?ja**-yvtho?
AOR-1sS-**flower**-plant
'I planted a flower.'
(Mohawk; Bonvillain (1974))

In the (a) examples, the structural object noun roots appear as independent lexical items with their own case marking. In the (b) examples, however, the noun roots appear inside the verbal complex, case and other inflections having been dropped. Also to be noted in Inuktitut is that the verb is inflected for both subject and object in the unincorporated form, but only for subject in the incorporated form.

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3. Grammatical Outline of Inuktitut

Inuktitut (IKT) is a language of the Eskimo-Aleut family, and encompasses several mutually intelligible dialects across Northern Canada. Typologically, it is noted for its highly polysynthetic nature and morpho-phonological complexity. Words typically consist of a noun, verb, or adverbial stem followed by from 0 to 8 or more lexical and grammatical morphemes, then an obligatory inflectional suffix, and finally optional enclitics.

Nominals are obligatorily marked for Case and number, and for person and number of possessor if applicable. Adjectival and other modifiers of the nominal which constitute separate words (i.e. not bound morphemes) are treated as nominals in Inuktitut and take the same person and number inflections as those on the nominal which they modify. Verbs inflect for both subject and objects in absolutive Case, but for neither objects in secondary Case nor incorporated objects. Word order is generally assumed to be basic SOV, though because Inuktitut is a pro-drop language it is relatively rare to encounter a sentence containing all of subject, object, verb, and other modifiers. Within a noun phrase, word order is much more rigid: possessors precede the head noun, and modifiers follow it.

4. Productivity

One of the great difficulties in any study of acquisition is determining the point at which a child begins using a morpheme or structure productively: to at least subconsciously recognize a certain morpheme as having a particular function of its own in the word-building processes of a language. We will adopt the criteria for productivity in Inuktitut, following Fortescue & Lennert Olsen (to appear). The first criterion is obviously the most clear and strong, with the second and third following in that order.

(3) CRITERIA OF PRODUCTIVITY

1. The morpheme in question is wrongly attached to its stem in terms of correct rules of phonology or morphology.
2. The morpheme in question appears in the transcript on at least two different stems, and preferably with two stems of phonologically different types so that two allomorphs of the morpheme are required.
3. Alternatively, the stem appears with a different morpheme attached in the same place, elsewhere in the transcript.

In terms of NI, it is most useful to refer to productivity of the verbs which allow incorporation since they are a much more restricted class than the nouns which may incorporate. An incorporating verb (henceforth, IV) will be termed productive, then, if it or the incorporated noun evidence attachment errors (criterion 1), if it appears in the transcript with at least two different nouns incorporated into it (criterion 2), or if the noun which incorporates into a particular verb appears elsewhere in the transcript either independently with nominal inflection or incorporated into another verb (criterion 3).

5. Inuktitut NI

This section investigates production data from one child speaker of Inuktitut, and illustrates that NI in Inuktitut is beginning to be acquired productively by at least 2;5. The data cited here are taken from 10 hours of videotaped naturalistic communication between an Inuk boy, Jaaji, and various members of his extended family, in Kangirsuk, Nouveau Québec. Tapings were done at 4-month intervals beginning at age 1;9. The sole language of interaction among family members was Inuktitut. Since no instances of NI were observed at 1;9, no data from that age will be considered.

5.2.1 Jaaji at 2;1

Jaaji's NI structures at 2;1 are not overwhelming, but they do exist. However, only one of the IVs fits the criteria of productivity and even this is questionable on the basis of native speaker intuition.

(4) a. Tii**tuq**.
tii-**tuq**
tea-**consume**
'(I want) to have some tea.'

b. Sikituur**tu**aluit . . .
sikituuq-**tuq**-aluk-it
skidoo-**ride**-EMPH-3pS
'They're riding skidoos . . . .'

The IV *tuq*, 'to use for its intended use', appears with several different incorporated nouns (henceforth, IN) of two phonological types which appears to be clear evidence for its productive use. However, each of these phrases is quite common in everyday speech, particularly that of young children, so it is conceivable that each is treated as an independent lexicalized unit. This hypothesis is strengthened by a mistake of omission shown in (5):

(5) * Umialauluuk?
umiaq-lauq-luk
boat-POL-1dS.IMPER
'Let's go for a boat ride?'

In adult speech the morpheme *tuq* must immediately follow the noun *umiaq*. Thus it seems that Jaaji may not have completely grasped the use of *tuq*, or may only be using it lexically, since he is not using it in all obligatory instances.

Two other IVs are productive under criterion 3: *laq* and *liaq* in (6) and (7):

(6) a. Kami**la**siviit?
kamik-**laq**-si-vit
shoe-**take.off**-PRES-2sS.INTER
'Are you taking your shoes off?'

b. Amiikka gaani.
kamik-Vkka gang-ani
shoe-1SduABS on.top-LOC
'My shoes are on the top.'

(7) a. Qangattajuu**liaq**.
qangattajuuq-**liaq**
airplane-**go.to**
'We're going to meet the plane.'

b. Qangattujuu!
qangattajuuq
airplane
'Airplane!'

In the (a) examples, the nouns in question appear incorporated into verbs, while in the (b) examples they appear as independent elements with appropriate nominal inflection.

5.2.2 Jaaji at 2;5

By 2;5 Jaaji has acquired three productive IVs and a fourth, *tuq*, is still inconclusive. First, *liaq* now meets the first criterion of productivity. It appears correctly with two different incorporating nouns, one shown in (8), and is also a clear victim of overgeneralization as shown in (9):

(8) Kuapa**lia**langvuruu.
kuapak-**liaq**-langa-vuguk
coop-**go.to**-FUT-1dS.INDIC
'We'll go to the co-op later.'

(9) * Avunngu**lia**ratta!
av-unnga-**liaq**-gatta
over.there-motion.to-**go.to**-1pS.PERF
'We're heading there!'

In (9), *liaq* appears with an adverbial of direction incorporated into it. While adverbs of place often incorporate in Inuktitut, this one is already marked for directional movement by the affix *-unnga* and so its incorporation into *liaq* is redundant and considered incorrect in adult speech.[1]

Two other IVs,*u* and *qaq* are also productive at this age. Both appear with various INs, though neither varies phonologically in a fashion relevant to productivity.

(10) a. Iqaluguluuvit?
iqaluk-ruluk-**u**-vit
fish-pitiful-**be**-2sS.INTER
'Are you a pitiful fish?'

b. Marquuluta.
marqur-**u**-luta[2]
two-**be**-1pS.IMAPP
'Let's be two of us.'

(11) a. Ataataqanngitutua?
ataata-**qaq**-nngit-juq-tuaq
father-**have**-NEG-3sS.PART-only
'He's the only one without a father?'

b. Umiajuaqarqugu.
umiajuaq-**qaq**-vugut
ship-**have**-1pS.INDIC
'We (too) have a ship.'

5.2.3 Jaaji at 2;9

Jaaji has slightly expanded his repertoire of IVs at 2;9: one by criterion 2, three by criterion 3, and three inconclusive. The most productive is the copula *u* 'be', which appears with various INs and in two allomorphs. Three additional IVs, *taaq*, *tuq*, and *si* are termed productive by criterion 3. Consider the data in (12) and (13):

(12) Taatialu paisikut**tu**gulu.
Taati-aluk paisikuq-**tuq**-ruluk
Taati-big bicycle-**ride**-pitiful
'Big Taati is pitifully riding a bicycle.'

(13) Imaittu**tu**rumaviit?
imaittuq-**tuq**-guma-vit
this.kind-**consume**-want-2sS.INTER
'Do you want some of this kind (of food)?'

Here *tuq* appears with two different nouns incorporated into it, demonstrating that it is likely productive, and the following two examples provide corroboration by illustrating each of the INs used with a different IV. In (14) *paisikuq* is incorporated into *taaq*, parallel with (12), and in (15) *imaittuq* is incorporated into *si*, parallel to (13). This comparison also indicates the productivity of the two comparison IVs

(14) Paisikut**taa**tu.
paisikuq-**taaq**-juq
bicycle-**acquire**-3sS.PART
'He got himself a bicycle.'

(15) Una kuukuumik imaittu**si**laarqanga.
una kuukuu-mik imaittuq-**si**-laaq-vanga
DEMsg kuukuu-INSTRsg this.kind-**buy**-FUT-2sS/1sO.INDIC
'Buy me some of that kuukuu, some day.'

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[1] Note that this observation holds only dialects of Inuktitut spoken on the Ungava coast. On the Hudson coast the sentence in (25) would be considered correct in adult speech. The child in question here does not have any regular contact with a speaker of that dialect.

[2] This verbal inflection is incorrect; it should be lunuk '1dS.IMPER'. However, this mistake does not influence the consideration of the productivity of NI.

5.3 Stranding

A more advanced step in acquisition of NI is the production of stranding structures. In stranding, lexical items such as adjectivals, numeral phrases and possessors which modify the noun and are included in the NP in unincorporated structures still exist and carry the same semantic relationships in incorporated structures, even though the noun which they modify has been incorporated into the verb complex and the modifier maintains its position outside the verb complex.

Production of stranding structures requires either the cognitive or structural ability to deal with the discontinuous dependency between the IN and its corresponding modifier, as well as the basic NI structure, and thus they constitute a more advanced step in the acquisition of NI. The child in this study did not produce any examples of stranding, which is not really surprising since it is undoubtedly more complex than NI itself and he was still in the beginning phases of dealing with NI. However we did encounter examples of stranding in observation of slightly older children in a nearby community. For instance, at about 3;0 the child was saying such sentences as in (16) with stranded numerals.

(16) **Marruunik aukulut**turumajunga.
marruuq-nik **aukulut**-tuq-ruma-junga
two-SECpl **chocolate.bar**-eat-want-1sS.PART
'I want to eat two chocolate bars.'

This concludes our look at NI acquisition data from Inuktitut. We will now look at some related data from other polysynthetic languages.

6. Greenlandic NI

Acquisition data from West Greenlandic (Fortescue & Lennert Olsen (to appear)), another dialect in the Eskimo-Aleut family, corroborates our findings from Inuktitut concerning NI. In addition, this data shows that basic stranding structures are certainly acquired by age 4;7. Examples from 4;7 and 5;2 are shown in (17) and (18) respectively:

(17) Anaana ilaa uanga napparsimallunga **pingasunik pinik**uuvunga.
anaana ilaa uanga nappar-sima-llunga **pingasut-nik** **pinik**-u-vunga
mummy right I sick-PAST-1sS.IMAPP **three-SECpl** **things**-be-1sS.INDIC
'I once got three when I was sick, didn't I, Mummy?'

(18) Taava qimmit toqugunik **allanik inissa**qannginnamikkit, ...
taava qimmeq-it toqu-gunik **alla-nik** **inissaq**-qaq-nngit-ramikkit
so dog-ABSpl die-4pS.IMPERF **other-SECpl** **place**-have-NEG-4pS/3pO.PERF
'So when dogs die, since they don't have any other place for them . . . .'
(Fortescue & Lennert Olsen (to appear))

In (17) the numeral 'three' refers to the quantity of things which the child got, and thus the two items 'three' and 'things' must be construed in a stranding structure. In (18), the modifier *allanik* 'other' is stranded from the NP, *inissaq* 'place', which it modifies.

7. Mohawk NI

Acquisition data from Mohawk, an Iroquoian language, show that NI in Mohawk is not acquired productively until after age 6. Mithun (to appear) presents acquisition data based on cross-sectional study of 5 children learning Mohawk as a first language. The children, aged 1;9 to 4;9, were each observed and recorded for at least half a day, in casual circumstances at either home or school. Examples of NI first appear in the fourth child, aged 2;10, as shown in (19), and then in the fifth child aged 4;9, as shown in (20):

(19) **ronkwe'áksen**
r-onkwe't-aks-en
MASCsgPAT-**person-bad**-STATIVE
'he is a bad man' (Mithun (to appear: 27))

(20) a. **kanahskwáksen**
ka-nagskw-aks-en
NEUTsgAGT-**animal-bad**-STAT
'it is a bad animal'

b. **iohnó:tes**
io-hnot-es
NEUTsgPAT-**water.level-deep**.STAT
'it is deep' (Mithun (to appear: 39))

However, Mithun (to appear: 39) states regarding all instances of NI in her data that "there is no reason to suspect that [they] created any of the forms [themselves]. All of the combinations [they] used are heard frequently, and in many cases the constituent roots do not occur alone, so the forms were most likely learned as lexical units".

This concludes our overview of relevant data. We now turn to possible explanations of the seemingly early acquisition of NI in Inuktitut with some reference to the contrast with Mohawk.

8. Possible Explanations of Differences

Presumably there are some factors in effect, whether structural or sociolinguistic, which make it more difficult for Mohawk children than for Inuit children to produce NI structures. Several possibilities are discussed below.

8.1 Verbal Affixation in Relation to N Root

One interesting structural difference to note is the placement of verbal affixation in relation to the incorporated noun. Agreement, tense, reflexive and other affixes *precede* the V in the Mohawk verb complex, while all these affixes and more *follow* the V in the Inuktitut verb complex. This is relevant for two reasons.

First is adjacency between the V and its affixes. Slobin (1985) observes in a cross-linguistic comparison of Japanese, Turkish, Polish and Hungarian that children evidence "preferences to keep grammatical markers of aspect, tense, and person close to the verb, while keeping negation and conditionality peripheral (Slobin 1985: 12)." This he attributes to the fact that tense and person are more inherently part of the meaning of the verb itself, while negation and conditionality have scope over the meaning of an entire clause. It is possible, then, that children might initially resist placing an IN in a position which increases the distance between a verb and its tense and person affixes. Since in Mohawk the IN must intervene in just such a position, most NI structures can be represented in an unincorporated form, and the process of NI tends to indicate a pragmatic effect encompassing the entire clause or sentence, children would presumably rather tend to leave the N unincorporated until later in the acquisition process. In Inuktitut, however, the IN does not block the adjacency of any affixes of person, tense, etc. since they all appear on the other side of the verb and therefore there is no reason why this factor of hierarchy of relevance should affect the acquisition of NI in Inuktitut.

Second, it has been shown that that morphemes at word boundaries are more salient to children than those inside the word. In Mohawk the IN is well-entrenched inside the verbal complex with various affixes on either side. In Inuktitut, on the other hand, the IN is always at the very beginning of the verbal complex. Thus it would not be surprising for the acquisition of NI to be influenced by this difference in salience of INs.

8.2 Criteria for Use of NI - Optional/Obligatory

A second possible explanation is that the criteria for use of NI are more restrictive or more clear in Inuktitut. NI in Inuktitut may be termed "obligatory" or "lexically governed" in that the verb into which the noun incorporates is only allowed to appear with an IN. NI in Mohawk, on the other hand is mostly "optional" or "stylistically governed" in that the verb which permits incorporation of nouns can also appear as an independent lexical item without an IN.

One possible ramification of this derives from Slobin (1985) who states that children have a preference for analytic over synthetic expressions. It is interesting to note here that those examples of NI which do appear in the Mohawk acquisition data are all examples of "obligatory" incorporation: both the adjectival V roots and the noun which is incorporated into it may only appear in incorporating structures. Thus the earliest NI expressions to emerge in Mohawk are those which have no analytic counterpart, and analytic forms are otherwise used in child speech until at least age 6. It is slightly problematic, however, that even when more or less equivalent analytic counterparts exist in Inuktitut they are acquired later than the synthetic NI structures.

A second possibility is that things which are lexically-governed are very clear in terms of which structure must be used. However, things which are stylistically-governed are quite a bit less clear and require more subtle interpretation. Therefore the child might find it easier in Inuktitut than in Mohawk to figure out when NI is to be used.

8.3 Degree of "Usualness" of NI in Adult Speech

A third possible reason for the early acquisition of NI in Inuktitut is the degree of "usualness" of NI in adult speech. When two or more structures are available to express basically the same meaning, and there is a feeling among native speakers as to which of the forms is the most usual, we intuitively expect the most usual form to be learned first, all other things being equal.

Mithun (1984) presents the thesis that in most cases of noun incorporation the unincorporated form is the norm and NI takes place for a specific purpose. In this situation a child would be expected to acquire the unincorporated form first, then alter it as necessary according to the pragmatics of the situation at hand. Since Mohawk follows this pattern, it is not surprising to observe that NI is acquired quite late.

Sadock (1986:25), however, notes that in many cases Greenlandic "provides no non-incorporated form of equal or less complexity and idiomaticity than the incorporated form." Thus it may well follow the pattern that in languages where NI is the normal and usual form ". . . it is not the case that 'speakers . . . incorporate for a purpose [Mithun (1984)]', but rather that they REFRAIN from incorporating for a purpose (Sadock (1986:21))".

In a language like Inuktitut where NI is considered the "most usual" way to represent the concept at hand, a child would most likely learn the incorporated form first and produce the unincorporated form only at a later date. In fact, unincorporated forms in Inuktitut only start appearing around age 4.

8.4 Degree & Intensity of Child Exposure to Language

The final possibility we will put forth is a more sociological one having to do with the degree and intensity of the child's exposure to the language being learned. If exposure is limited to a few times a week, short periods daily, or conversing with only one or two conversational partners in that language, acquisition is likely to progress more slowly than in an environment where the language is being used on a daily basis by almost all speakers.

The Mohawk living environment certainly does not present the ideal situation for language learning. Mohawk is a language suffering fairly rapid attrition. It is spoken proficiently by adults of grandparent age, but few children are currently acquiring it as a first language and it is not very prevalent as a language of everyday use. On the other hand, the preferred and by far most common language of interaction in the Inuit settlement we studied is Inuktitut. On the basis of this information it would not be unreasonable to suspect a differential level of exposure to the respective native language in the two societies, leading to differential acquisition in favor of Inuktitut. In fact, it almost seems that the Mohawk situation is an L2 rather than L1 learning situation. While it is unlikely that the acquisition of a structure per se would be radically affected by such a factor, the grasp of a structure used predominantly for semantic purposes might be since less exposure to the language may well decrease the speed with which the child picks up semantic nuances. This would be especially relevant to NI in Mohawk since NI is used in that language for primarily semantic purposes (Mithun (1984)). It is certainly possible, however, that under more empirical testing no effect is evidenced.

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Why do children omit subjects?[1]

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It is well known that children acquiring English frequently produce utterances with missing constituents. This paper is concerned with why children produce sentences without subjects, like those shown below (from Bowerman, 1973).

(1) hug Mommy
play bed
writing book
see running

One theory of these utterances is that young children represent different grammars than adults. In particular, Hyams and her colleagues have proposed that all children start off with a pro-drop grammar, one where overt subjects are optional (e.g., Hyams, 1986). This is the correct grammar for a pro-drop language like Italian but incorrect for a non pro-drop language like English, where overt subjects are obligatory. So children acquiring English need some sort of evidence in order to change their grammar from pro-drop to non-pro-drop. There are several different proposals of exactly what sort of input causes the parametric switch (e.g., Borer and Wexler, 1988; Hyams, 1986, 1987; Pierce, 1987).

In this paper, evidence is presented for an alternative explanation, which is that young children represent the correct grammars from the very start but omit subjects because of performance factors. This performance explanation of subjectless sentences motivates a considerable shift in how we look at the acquisition of pro-drop and non-pro-drop languages.

Comparing the processing theory with the pro-drop theory

Before discussing the empirical evidence, it is worth considering one strong motivation for assuming that such a processing limitation exists. It is often argued, on both empirical and theoretical grounds, that young children represent the same sort of linguistic rules and principles as adults (Bloom, 1989; Chomsky, 1986; Hyams, 1986; Pinker, 1984). But if this is true, then why are children's utterances so short? Why is there a 2-word stage at all? One answer--in fact, the only one ever proposed--is that while children represent the same sort of knowledge as adults, they have problems using this knowledge, some sort of processing bottle-neck. To put it another way, the only way to coherently hold on to the view that children represent adult-like grammars is to suppose that what they say is not an adequate reflection of what they know.

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On the empirical side, there is considerable evidence for processing limitations in child language. For one thing, length limitations show up even when children imitate adult speech. The length of a young child's imitation of an adult sentence is not predicted by how long the adult sentence is, but rather by how long the child's spontaneous utterances tend to be (Brown and Fraser, 1963). This hints that the reason children's utterances tend to be short has nothing to do with their grammars, but is due to a general inability to utter long strings of words.

Further, children omit not only subjects, but also direct objects, indirect objects, verbs, locative arguments, and so on. In fact, much of the early debate over missing constituents in child language concerned sentences without verbs (Bloom, 1970; Bowerman, 1973; Braine, 1974; Brown, 1973). As Brown (1973) notes, often children appear to be producing two- or three-word subsets of longer sequences. Instead of saying *I put the book on the table*, a child might say *I put* or *put book* or *put table*, and so on. The most parsimonious explanation of such utterances should account for all the omissions in child language--not just missing subjects.

Finally, Mazuka, Lust, Wakayama, and Snyder (1986) point out that some children go through a stage where they neither include the subject nor do they omit it. Instead, they reduce it to a schwa (see Bloom, 1970). This would follow if children have difficulty uttering subject NPs but know they are required and thus make some effort to produce them. This behavior is entirely mysterious from the standpoint of the pro-drop hypothesis, which predicts that children will either include the subject or omit it.

While all of this is suggestive, it hardly makes for a knock-down argument in favor of the processing theory. Therefore it becomes interesting to try to compare the pro-drop theory and the processing theory more directly. One way to do this is as follows:

Syntactic complexity and subjectless sentences

If subjects are omitted because of processing difficulties we would expect them to be omitted more frequently from longer structures than from shorter ones. Therefore, the subjectless sentences that children produce should tend to have longer VPs than their sentences with subjects, because long VPs exert more of a processing load than short VPs.

This prediction was first tested by Bloom (1970), who studied a 22-month-old child's use of one verb -- *make*. She predicted that subjects should be omitted more frequently with long VPs, so a child would be more likely to omit the subject if the VP was something like *make me a cake*, than if it was *make cookie*. Bloom found 45 sentences with the verb *make*, 13 with subjects and 32 without. The mean lengths of the VPs were 2.77 and 3.25 respectively, a significant difference ($p < 0.05$, one-tailed).

A few years later, Braine (1974) performed the same sort of analysis on the spontaneous speech of two children, one acquiring English (Jonathan), the other acquiring

Hebrew (Odi). He found no significant differences in the mean length of VPs for subjectless sentences versus sentences with subjects. He concluded that there is no length limitation on children's language production, which runs counter to Bloom's finding and apparently refutes the processing theory. However, there are certain problems with Braine's study that make accepting his conclusion premature.

First, some of the utterances that he counted as VPs did not actually include a verb, but were instead "marked by the content of the utterance as including actions". It is not clear whether these should have been included. Presumably many of them--particularly those that were only one word long--did not actually require a subject at any representational level. Therefore including such utterances might have spuriously lowered the mean length of sentences classified as "subjectless VPs".

A related problem is that Braine included requests, statements, and questions in his analysis of Jonathan's speech and statements and questions in his analysis of Odi's speech. But some requests and questions do not require subjects, such as *give that to me!* and *want a cookie?*. As such, they have a different status than VPs where the subject actually has to be there and are irrelevant to both the pro-drop hypothesis and the processing hypothesis.

Finally, adult Hebrew *does* allow for null subjects in some contexts, and therefore some of Odi's subjectless sentences may actually be pro-drop utterances. None of the arguments against the pro-drop hypothesis concern children's subjectless sentences in languages where such sentences are acceptable; the interesting debate is over the status of subjectless sentences that are unacceptable in the adult grammar.

In light of these problems, I decided to do an analysis similar to what Braine did, using a broader data base and controlling for the problems mentioned above.

Analysis

Subjects

The subjects were three children studied by Brown (1973): Adam, Eve, and Sarah. Transcripts of their speech are stored in computer text files as part of the CHILDES data base (MacWhinney and Snow, 1985) and a computer search program was used for all analyses. Adam's speech was studied from 10 2-hour samples taken from the ages of 2;3 to 2;7, Eve's speech was studied from 10 2-hour samples taken from the ages of 1;6 to 1;10, and Sarah's speech was studied from 20 1-hour samples taken from the ages of 2;3 to 2;7.

Procedure

The hypothesis is that children's subjectless sentences will tend to have longer VPs than sentences with subjects. One necessity when doing such an analysis is to exclude subjectless sentences that are in fact acceptable in the adult grammar, such as imperatives and some questions. Because of this, only utterances with two types of verbs were used. These were (i) past-tense verbs, which cannot be used as requests or imperatives (e.g., *wanted*), and (ii) verbs that denote cognitive states or involuntary acts (e.g., *need*). This second type will be called "non-imperatives", since they can almost never appear in the imperative form. There were a total of 48 past-tense verbs and 20 non-imperatives used in the search.[2]

For the analyses below, questions, statements with *no* or *don't*, statements where the verb is part of an embedded clause, and rote imitations of adult speech were not included.

Results

Each child's utterances were analyzed separately for the two verb types, through one-tailed *t*-tests comparing the VP-length between sentences with and without subjects (see Figure 1 at the end of the paper). In all cases but one, the difference was statistically significant. The exception was Sarah [Past-Tense Verbs]; although the difference was in the right direction, it was insignificant (possibly as a result of the low sample size). When the two verbs types were counted together, however, there was a significant effect for each child, including Sarah. These results strongly confirm the predictions of the processing theory.

An alternative theory of the length difference

There is another explanation of the length difference that is worth considering, one consistent with the pro-drop hypothesis. Children may omit a subject only when they believe its meaning can be inferred by the listener from context. If long VPs supply more of the relevant context than short VPs, this would explain why subjectless sentences tend to have longer VPs than sentences with subjects.

We can compare this explanation and the processing account in the following way. Suppose some of the children's utterances have long subjects (e.g., *the big mean lion*) and others have short subjects (e.g., *you*). The processing account predicts that the former class of sentences should have shorter VPs than the latter, since a long subject imposes more of a processing load. In sum, we would predict a gradual decrease in the length of the VP as a function of subject size, as shown in (2). The pragmatic hypothesis, in contrast, predicts no difference between overt subjects of different lengths, so long as they all have unambiguous reference. This is shown in (3).

(2) **Processing theory--predictions about VP-length**
no subject > short subject > long subject

(3) **Pragmatic theory--predictions about VP-length**
no subject > short subject = long subject

Unfortunately, children at the ages where they omit subjects rarely produce subjects that are more than one word long. But we can compare the theories by contrasting pronoun subjects with non-pronoun subjects. Since pronouns are phonetically shorter than non-pronouns, the processing theory predicts some difference in VP-length as a function of whether or not the subject is a pronoun. As long as both the pronoun and non-pronoun subject are unambiguous, no such prediction would come out of the pro-drop hypothesis.

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[2] These were taken from an exhaustive list of verbs previously compiled from the speech of Adam, Eve, and Sarah by Michelle Hollander, as part of an unrelated study. I am grateful to her for providing them to me.

The prediction was tested using the data compiled above. Since it is important that all subjects in this analyses be unambiguous, the only pronouns included were *I* and *you*, since pronouns like *she* or *they* are often ambiguous and could require a longer VP because of this. The analysis was done collapsed over verb types; the results are shown in Figure 2 at the end of the paper.

The length of the VP clearly decrease as a function of the size of the subject. Contrast analyses testing for a linear trend in VP-length as a function of subject size showed a significant effect for each of the three children.

Why are subjects omitted more frequently than objects?

Finally, I want to briefly consider the question of why subjects are omitted more frequently than objects. Across the three children, 55% of their declarative sentences have missing subjects. In order to calculate the proportion of missing objects, we have to look only at contexts where verbs must take an obligatory object. This can only serve as an estimate, because it's not at all clear whether the adult intuition about which verbs take obligatory objects is going to be the same as the child's.

Nevertheless, when we do the analysis, it turns that children omit the object a total of 9% of the time, which is surprisingly high according to some accounts, but also significantly different from the proportion of subject omission. Every child omitted objects some of the time, and every child omitted subjects more frequently than objects (see (4)).

(4) **Omission from obligatory contexts**

	Adam	Eve	Sarah	Total
SUBJECTS:	57%	61%	43%	55%
OBJECTS:	8%	7%	15%	9%

If the subject/object difference is due to a processing asymmetry, we should expect to find other differences between subjects and objects. For one thing, given that pronouns don't exert much of a processing load, we would expect them to be more frequent in subject position than in object position. This seems to be the case -- for each child, there is a greater proportion of pronoun subjects than pronoun objects (see (5)). Another prediction is that non-pronoun subjects will be shorter in length than non-pronoun objects, a difference that also occurs (see (6)). When we sum up over the three children, both of these differences are highly significant.

(5) **Proportion of overt NPs that are pronouns**

	Adam	Eve	Sarah	Total
SUBJECTS:	41%	36%	91%	**51%**
OBJECTS:	25%	14%	33%	**24%**

(6) **Mean Length of non-pronoun NPs**

	Adam	Eve	Sarah	Total
SUBJECTS:	1.18	1.26	1.00	**1.16**
OBJECTS:	1.43	1.63	1.48	**1.59**

It's worth stressing that these are all independent analyses; just because subjects are omitted more frequently than objects, it does not follow that pronominal subjects will be more frequent than pronominal objects, or that non-pronoun subject NPs will be shorter than non-pronoun object NPs. In fact, these two other differences are a mystery from the standpoint of the pro-drop hypothesis. The most natural way to explain all three effects is in terms of processing load; there are more resources available for the end of the sentence than for the beginning. As a result of this processing asymmetry, subjects are omitted more frequently than objects, pronouns are more frequent in subject position than object position, and subjects tend to be shorter than objects.

Discussion

Once we have an alternative explanation for why children omit subjects, there is no independent reason to hold onto the pro-drop hypothesis. In fact, the position that children acquiring English represent pro-drop grammars until they are about two-and-a-half or three leads to a host of problems. For one thing, you need some sort of account of why the child goes so long without switching to the adult grammar. Some theorists appeal to neural maturation or "selective attention" as explanations for why the pro-drop stage lasts so long. While these proposals are logically possible, they are ad hoc, and have little independent support. Furthermore, there is the problem of determining exactly what information causes the pro-drop to non-pro-drop shift. To date, none of the proposals of what causes the parametric switch have met with convincing empirical support.

Finally, the alternative view, which is that all children start off with non-pro-drop grammars, runs into none of these problems. Under this theory, children initially represent overt subjects as obligatory (as in English) and only when hearing subjectless sentences do they change their grammars to pro-drop (as in Italian). It turns out that 2-year-olds acquiring Italian omit subjects far more frequently than 2-year-olds acquiring English (Valian, 1989), which suggests that the switch from non-pro-drop to pro-drop takes place very early in the development of a child learning a language like Italian.

The hypothesis that all children initially represent pro-drop grammars has led to some very interesting theoretical and empirical speculation. However, the data fail to support this hypothesis. Instead, it appears that children acquiring English omit subjects because of a processing limitation on language production and that all children initially represent non-pro-drop grammars.

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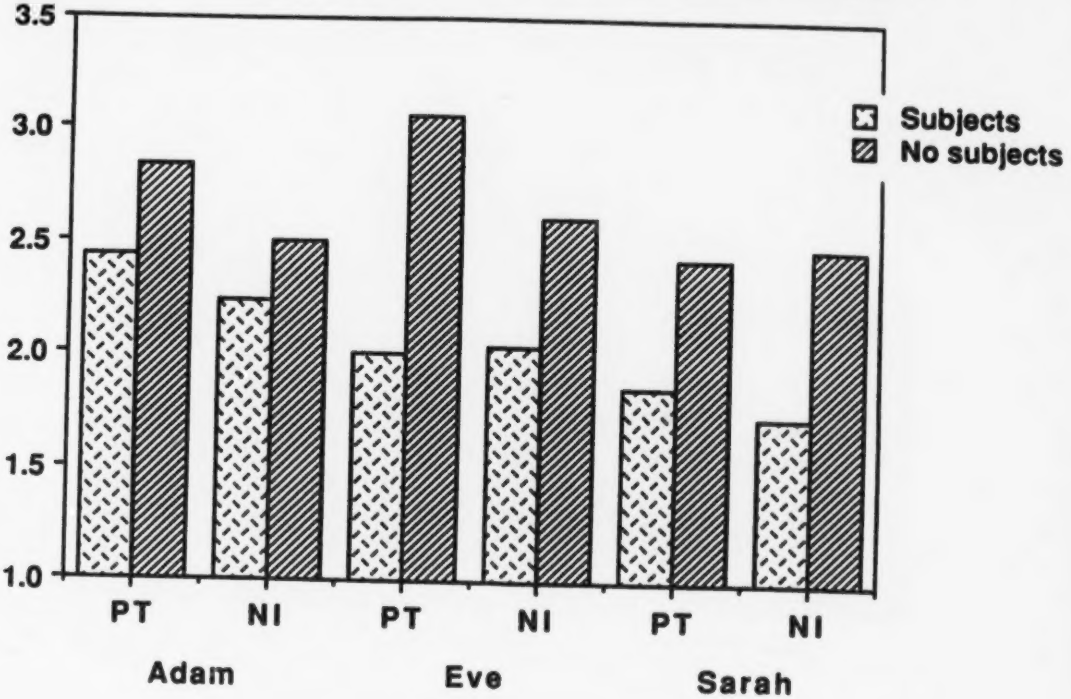
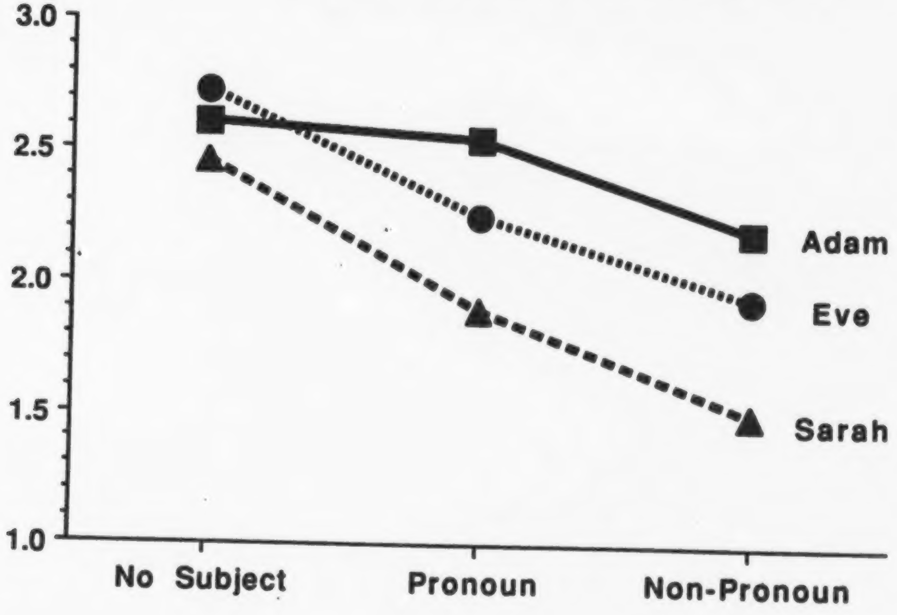
Figure 1: VP-length in sentences with and without subjects



PT = Past Tense verbs
NI = Non-Imperative verbs

Figure 2: VP-Length as a function of subject size



ACQUIRING LANGUAGE IN A CREOLE SETTING: THEORETICAL AND METHODOLOGICAL ISSUES

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The challenge of acquisition in Creole environments

Creole environments offer an opportunity for the study of language acquisition in settings which contrast strongly with those in which mainstream thought in language acquisition studies has been established. In Creole environments, the target of the learner is ill-defined both because of the intensely variable nature of the input and because of the absence of exactly pertinent grammatical descriptions. These circumstances present a theoretical and methodological challenge to the analyst, viz. the determination of the true target of acquisition, the nature of acquisition in the face of such a variable environment as well as the internalization of control of meaningful variation by a learner. This paper will elaborate on the challenge and suggest a method for developing a corpus for study in such environments.

The usual environment for acquisition studies

Although variation is present in all language acquisition settings, it has not been a purposefully included conditioning factor of the mainstream study of language acquisition. Orthodox knowledge of language acquisition has been established by studying children who are exposed to a limited number of previously described language varieties (and preferably one) modelled by formally educated mainstream users. The child is supposed to be acquiring a specified language for which an ample referential description is available. These descriptions have tended to be of the static type in which variation is a footnote rather than a determinant of the description. By contrast with Caribbean sociolinguistic complexes, such homogeneous environments may be termed sterile.

Types of learning environments in the Caribbean

The Caribbean sociolinguistic complex is a rich environment which obliges the analyst to cope with variation in much the same way as the child learner. Several types of micro-settings may be identified.

Type I. Consistent monolingual The consistent monolingual environment is the classic monolingual environment and it is atypical of the Caribbean. Speakers would interact in the presence of the learner and with the learner in a single code. Shifts of register, style or situational variety would be linguistically within a single grammatical system. In strict terms, available audio-visual media would be in the variety used by the speakers in the accessible environment.

Type II. Leaky monolingual Much more common would be the leaky monolingual environment in which those who interact with the learner produce a single code, but the learner is exposed in addition to another code from audio sources lacking the physical presence of a speaker or other pragmatic context for interpretation.

Type III. Monolingual with secondary input In the third kind of environment, monolingual with secondary input, another code is present in the environment and is supported by pragmatic contexts although the immediate caregivers do not themselves use it. The important difference between this setting and the Type II setting is that the secondary language is overheard in contexts that have pragmatic support. This type of environment is much more prevalent than the Type I environment.

Type IV. Special case in multi-code environment The fourth type of micro-setting may be summarized as one in which the learner is a special addressee. The immediate socializers have more than one variety available but use only one with the learner in keeping with a household decision about what language they wish the learner to acquire.

Type V. Routine case in multi-code environment In the fifth case, the routine case, the learner is addressed in only one of the available codes of the socializers in keeping with a general community convention (as opposed to the household decision of type IV) that a specific variety is the appropriate one for use with children.

Type VI. Open access In the open access case, the socializers command more than one code and the learner is not excluded from any of them. The difference between Type VI and Type V may be important at later stages of acquisition when reported asymmetries in child-parent communication have the effect of obliging children to use varieties closer to the standard than those used by their parents.

Obviously, one can study acquisition in any setting but the high frequency and commonplace nature of the Type V/VI environments recommends them as primary for study in the Caribbean sociolinguistic complex.

Linguistic repertoire vs Language

Within the above micro-settings, several different factors may be responsible for variation including the existence of a creole dialect continuum and the practice of code switching. The notion of a creole dialect continuum has dominated the literature on Caribbean speech varieties for nearly 2 decades. Its characterization, analysis and exemplification in the work, inter alia, of De Camp (1971), Bickerton (1975) and most recently Rickford (1987) attests to the virtual inevitability of variable data in Caribbean environments. Current continuum theory treats drift across lectal boundaries within a multi-dimensional sociolinguistic space which is presented as a single interlocked system. Variation is intrinsic to such a construct.

Code switching in response to established social cues can be noted as a contributor to the variation that is characteristic of the Caribbean sociolinguistic complex. Code switching may also result from a speaker's inability to complete a communication in a given code because of a break in competence. Thus, although a conventional analysis of a speaker's behaviour may assign parts of his performance to different language systems, his speech behaviour may constitute a single system of communication within the relevant Caribbean society.

In these circumstances, the salience of variation challenges the notion that a learner is acquiring a language, a pre-existent entity. A large proportion of children acquire a speech repertoire that may include varieties that cannot be unequivocally ascribed to a single language. Rather than acquiring a language, these learners would be acquiring a linguistic repertoire that allows them to interact within their societal range. We therefore need to focus on the idea "linguistic repertoire" rather than the idea "a language". The point is critical for shaping relevant field procedures and analytical processes.

Pinning down the variable target

The first challenge for the study of acquisition in a Caribbean socio-linguistic complex is the determination of the target of the child given that variation is present and influential at the level of the individual household. Information from the environment of an informant P illustrates the extent to which a single household can offer variable exposure and output.

Recorded between 2;8 and 3;0, P is the second youngest of 7 children in a household. Her mother [J], a teenager, her grandmother [M], almost 40, and her grandmother's husband [R], late 40s, show very different varieties of the spectrum of possible speech in rural Trinidad. Her grandmother had secondary level education up to the 5th Form (approx age 16) in a semi-urban setting; her grandmother's husband has had limited elementary schooling in a rural setting; her mother left secondary school in their village setting at Form 2 (approx age 13); four of the other children in the household are at school.

Examples of the variation to which the learner is exposed are presented in the appendix. Drawn from the same 30 minute recording, these examples of input and ambient language illustrate variation in pronominal selection, tense-aspect marking, and form of a locative question word in the speech of the child's grandfather, grandmother and mother. In an environment of such diversity, it becomes important to be able to identify the direction of movement of the informant.

Let us assume that within the household Concept C is expressed by variants V_1, V_2, V_3 ... V_n (where the variant is a form, element or structure). The learner at some initial point may be recorded as producing a form F_1. If we are to track movement towards a target we need to ascertain which of variants V_1 ... V_n is being represented by F_1. It will be frequently easy, sometimes difficult and at other times impossible to tell. However, it is pertinent and important to attempt to determine which variant the household considers that the learner is targeting or ought to be targeting, since it is ultimately their response to her output that will contribute to its realignment in the socially acceptable direction.

Working without a grammatical description

The second challenge for the study of acquisition in such environments arises from the fact that no existing descriptions of the systems of communication would allow the analyst to have a predetermined reference point for the target of the learner. The disadvantage of this circumstance is more apparent than real. The fact is that there can be no valid description of a learner's target unless that description is derived from the interactions of the learning environment. A corpus created in accordance with that principle would have the characteristics of being a valid representation of actual input and ambient language, permitting focus on the relationship between form and function as the child perceives it, and ensuring that judgments of grammaticality and acceptability are based on data actually available to the learner rather than on a grammar that is hypothetical as far as the learner and his/her immediate environment are concerned.

This position does not deny the value of the already published analyses of Caribbean language varieties; it places them in a different perspective, a function of ultimate reference rather than assumed target of the learner. The true target of the learner can be defined and described realistically only by examining the available rather than the purported input and ambient language. The corpus for study would be created by the recorded interaction between the learner and the participants in his exposure to communication. Both the description of the target communication system (i.e. the community language) and the description of the acquisition process must come from those data.

An important secondary resource

Satisfactory acquisition is the fulfillment of norms expected by the environment; hence, it is necessary to determine which variants the household considers that the learner is targeting or ought to be targeting. In this regard, the participants in the interactions recorded with the child can be invited to state what they consider the learner to have said and thus provide access to their perception of grammaticality. This procedure would be similar to the elicitation of repairs which has been applied to other purposes including tests of children's understanding of various concepts and structures. In this instance, it can provide knowledge on the expectations of speakers of the target varieties and allow establishment of one major criterion of satisfactory acquisition. In addition, it would enhance our knowledge of variation by providing indices of the expectations of the adult users of the system of communication.

Acquisition of acceptable control of variation

In Caribbean sociolinguistic complexes, variation is not only diagnostic of speaker history but also functional within communication acts. Hence, part of what a learner needs to acquire is control over socially appropriate variation. Children acquiring language in a Caribbean sociolinguistic complex need to learn the different sets of linguistic behaviours that are acceptable within the same community context. This may not differentiate these environments from other learning contexts but there is a potentially more compelling consideration that makes attention to this detail important.

Of special relevance to Caribbean sociolinguistic complexes is a conclusion of Le Page and Tabouret-Keller (1985) on the evolution of speech behaviour and self-identity which can be paraphrased as follows:

> Individuals create their system of verbal behaviour to resemble that of the groups with which they wish to identify, subject to the constraints of their ability to identify the groups, the strength and clarity of their motivation, the adequacy of their opportunities for learning and their ability to learn.

Their work adequately supports this view and it is clearly relevant to choices in variable socio-linguistic space. One cannot study language acquisition in these environments without including the acquisition of variable behaviour and of knowledge on tolerance of difference within the speaker's immediate environment. The child learns how to maintain group membership, and how to manipulate variants without threatening desired relationships. It is these skills which control the shift behaviour that has been discussed repeatedly in respect of continua.

Summary

The study of language acquisition requires that the analyst identify the learner's target and have available a grammatical description of the target. In the case of the Caribbean Creole environment, special caution is required in identifying the learner's target because substantial variation is intrinsic to the input and ambient language. Existing studies of language varieties in the region must not be assumed to provide appropriate descriptions of the input or ambient language for a particular learner. Both the description of the language to be acquired and the account of the process of acquisition must be based on the same corpus produced in the learning environment by the learner and the participants in his/her language socialization. The corpus can be enhanced by eliciting from the participants their notion of what the learner is attempting to say and ought to be saying. This procedure is important for providing access not only to notions of grammaticality but also to notions of appropriateness. Given the interlock between speech behaviour and identity in these settings, attention has to be devoted to the acquisition of ability to manipulate socially linked variants of a variable.

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APPENDIX

Examples of variation in input and ambient language

Age of child 2;8 Date 4th February 1988

Feature: Pronominal form

Utterance #	Speaker	Utterance
13	grandfather (general, about child, in presence of child)	a gʌ̃ tek ɪt ɔt frʌm ʃɪ bikɔ ʃɪ tu ba·d. I'll take it away from her because she's too naughty.
16,17	grandmother (to child in reference to sibling)	let ʌ kʌm ɪn, let ʌ kʌm ɪn. Let her come in, let her come in.
138	grandfather (to child, message to be conveyed to mother)	tel hʌ kʊk (xxx) fʊ mi. Tell her to cook one for me.
244	grandfather (to child, in reference to sibling)	tel ʃɪ kʌm ɔwt! Tell her to come out.

Feature: WH locative

Utterance #	Speaker	Utterance
67	mother (to child)	we jʊ goɪn? Where are you going?
80	grandfather (to child)	an wɛtʃpat jʊ kipɪn jʊ kreɔn? And where would you keep your crayons?

Feature: Tense-aspect marking

Utterance #	Speaker	Utterance
23	grandmother (to child)	hu gev ju dat pɪtʃʌ? Who gave you that picture?
30	grandmother (to child)	hu giv ju di tʃɛ? Who gave you the chair?

CHILDREN'S KNOWLEDGE OF RELATIVE SCOPE IN CHINESE

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In this paper, we present some results of an experiment which was designed to investigate how Chinese children and adults would interpret sentences containing universal quantifiers and existential quantifiers such as the examples given in (1) to (4). [(1) & (2) are canonical constructions; (3) & (4) are Chinese ba-constructions.]

(1) Draw a/every figure in every/a box.
(2) In a/every box draw every/a figure.
(3) Ba a/every figure draw in every/a box.
(4) Ba a/every box draw every/a figure.

According to current literature (c.f., J. Huang,1982; Lee, 1986; Aoun & Li, to appear), the scope facts concerning two quantifiers in a simple sentence do not hold across languages. In English, it is generally agreed that the scope relation of quantified noun phrases is free within the minimal sentence and thus allows various scope ambiguities. However, in Chinese, no such free property is attested. In many cases, Chinese sentences are strictly unambiguous. This cross-linguistic difference in scope relations is exhibited by the English example given in (5) and its Chinese counterpart given in (6).

(5) Every child sang a song.
(6) Meige xiaohai dou chang le yishou ge.
every-CL child all sing Asp. one-CL song
"Every child sang a song."

Sentence (5) "every child sang a song" is two-way ambiguous. It can mean that different children sang different songs where the universal quantifier NP (Q-NP) "every child" takes wide scope over the existential quantifier NP "a song". This sentence can also mean that the children all sang the same song where the existential Q-NP "a song" is said to take wide scope over the universal Q-NP "every child". The equivalent Chinese sentence given in (6), however, has only one meaning. It corresponds to the wide scope reading of the universal Q-NP "meige xiaohai". Namely, different children might sing different songs.

A rule of Quantifier Raising [as given in (7)] and two general conditions on Quantifier Raising were proposed by May (1977, 1985) to explain the scope ambiguity of sentence (5) and many other quantificational sentences. He argued that there was a level of Logical Form (LF) in syntax where generalizations concerning quantificational phenomena such as scope relations could be captured. In an LF representation, if one quantified NP c-commands the other quantified NP then the c-commanding one takes wide scope over the c-commanded one. The notion of "c-command" may be understood in the way stated in (8).

(7) Quantifier Raising Rule:
Chomsky-adjoin a quantificational NP to S.
(8) C-Command:
A c-commands B iff A does not dominate B and the first branching node which dominates A also dominates B (c.f., Reinhart, 1976).

By applying the rule of Quantifier Raising (QR) to the S-structure representation, the two quantified NPs in sentence (5) could be freely moved to adjoin to the S node, successively. Since there are no other conditions on the application of the QR rule nor other constraints on the output after applying this QR rule, an S-structure like (5) can be transformed into two well-formed LF representations as given in (9) and (10).

(9) $[[\text{Every child}]_i\ [[\text{a song}]_j\ [x_i \text{ sang } x_j]_s]_s]_s]$

(10) $[[\text{A song}]_j\ [[\text{every child}]_i\ [x_i \text{ sang } x_j]_s]_s]_s]$

In the LF representation (9), the universal Q-NP "every child" c-commands the existential Q-NP "a song". The universal Q-NP thus takes wide scope over the existential Q-NP and thus implies that "different children might sing different songs". In (10), on the other hand, the existential Q-NP "a song" c-commands the universal Q-NP "every child". The existential Q-NP thus takes wide scope over the universal Q-NP and implies that "the children all sang the same song".

There exist at least three proposals expressly designed to explain the scope facts of Chinese sentences. Based on a wide range of data, Huang (1982) examined quantifier scope in Chinese. He claimed that while the rule of Quantifier Raising and the notion of structural c-command were both relevant in the determination of scope relations in Chinese, the application of the QR rule in Chinese was not as free as that observed in English. In order to interpret the scope phenomena of Chinese sentences and to explain the contrast between Chinese and English as shown in examples (5) and (6), Huang proposed a general condition on scope interpretation for Chinese (1982: 220). This general rule [also known as the Isomorphic Principle], as given in (11), states that, for Chinese quantificational sentences, if a quantified NP A c-commands another quantified NP B in Surface-Structure, this quantified NP A will also c-command the quantified NP B in Logical Form. In other words, throughout the process of SS to LF mapping performed by the QR rule, the c-command relationship between two quantified NPs at S-Structure is preserved at Logical Form.

(11) Huang's General Condition on Scope Interpretation in Chinese
"Suppose A and B are both QPs or both Q-NPs or Q-expressions, then if A c-commands B at S-Structure, A also c-commands B at Logical Form"

Consider the Chinese sentence (6) again. At S-structure, the universal Q-NP "meige xiaohai (every child)" c-commands the existential Q-NP "yishou ge (one song)". According to the general constraint stated in (11), the c-command relation between these two quantified NP will stay the same in LF (after the application of the QR rule). As a result, sentence (6) is not ambiguous.

A slightly different proposal was made by Lee (1986). Following Huang's proposal, Lee argued that the hierarchical relation between two quantified NPs in a sentence was relevant for the determination of scope relations in Chinese, but instead of "c-command", the relevant hierarchical relation should be expressed in terms of "g-command". In addition, Lee claimed that both the notion of linear order and that of hierarchical relation, namely g-command, were relevant to scope interpretation in Chinese. By incorporating these two notions, Lee revised Huang's general condition for scope interpretation in the following way [see (12)]:

(12) Lee's General Condition on Scope Interpretation in Chinese
Given two quantified NPs A and B

(i) if A asymmetrically g-commands B, A will have scope over B;
(ii) if A and B g-command each other, then A can have scope over B only if A precedes B (1986: 187).
[A g-commands B iff the node representing the governing category of A dominates B, where "governing category for an element A" is defined as "the minimal category that contains A and a SUBJECT".]

In (6), the governing category for the universal Q-NP "every child" is the whole sentence which also serves as the governing category for the existential Q-NP "a song". Accordingly, these two quantified NPs g-command each other, and therefore the preceding NP "every child" takes wide scope over the succeeding NP "a song". Since in Chinese sentences such as (6), the hierarchical order of c-command is confounded with that of g-command and linear precedence, additional data besides sentence (6) are required to evaluate these two analyses suggested by Huang and Lee. [We postpone the discussion of the related data until the experimental design and the outcomes are examined.]

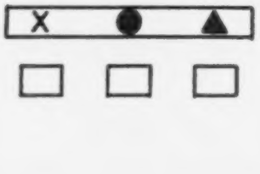
Another analysis which was proposed to account for the scope phenomena of Chinese was introduced by Aoun and Li (to appear). They challenged Huang and Lee's Isomorphic Principle by showing that there were instances in Chinese which did not exhibit this isomorphic effect. We will not discuss Aoun and Li's proposal in detail, but just want to point out that their analysis and Huang's analysis predict exactly the same results concerning the sentences tested in our experiment. In order to differentiate Aoun & Li's theory from Huang's theory, one has to consider Chinese passive constructions.

The purpose of our experiment was to get preliminary evidence on whether Chinese children understand scope relations and whether they know which relations are possible for particular syntactic configurations. For the most part linguists agree on the judgments of scope relations. However, in the one case (tested in our experiment) where Lee's model disagrees from Huang's there appears to be not complete agreement on the adult judgments. Therefore, in addition to child subjects we also tested adult subjects. Their judgments regarding this one controversial case were carefully examined. Moreover, by examining adults' data, the validity of the experimental method was assessed. Since the relationship between behavior and scope interpretation is particularly complicated (see our later discussion on "accidental" narrow scope), adult data is particularly useful when studying scope. For an earlier discussion of the acquisition of scope in Chinese, see Lee (1986).

THE EXPERIMENT

In the experiment, an act-out task was used to test Chinese-speaking children and adults' interpretation of sentences involving two quantificational NPs. The subject was first presented with a sheet of paper with an array of three equally sized squares and a card with an array of three different figures (or numbers), or a set of three markers of different colors. The subject was then presented with a test sentence (e.g., "Draw every figure in one box") and asked to perform the action prescribed in the presented sentence. An example of the layout of the experimental materials is illustrated in (13).

(13)



Sixteen different types of experimental sentences were included in this study. Half of the experimental sentences were canonical sentences [examples are given in Table 1 and Table 2]. The other half were Ba-constructions such as those illustrated in (3) & (4) above [which will not be discussed in this paper]. According to their syntactic structures, we classified the canonical sentences into two major groups. Group 1 consisted of four constructions as shown in (15) & (16) [see Table 1] and (21) & (22) [see Table 2]. These four constructions shared the structural representation given in (14) [which is repeated in (20)]. Group 2 consisted of another four constructions as shown in (18) & (19) [see Table 1] and (24) & (25) [see Table 2]. They shared the structural representation illustrated in (17) [which is repeated in (23)].

Let us first examine the structural configuration given in (14) [=(20)]. Following Huang's analysis (1982), if we assume that c-command can be relaxed to allow for an NP object of a preposition to c-command across a dominating PP node, then, in (14), NP_2 c-commands NP_1, but not vice versa. According to Huang's scope principle given in (11), NP_2 should take wide scope over NP_1. In this configuration, NP_1 and NP_2 share the same governing category, namely the S node. Thus, according to Lee, these two NPs g-command each other. Applying Lee's scope principle (given in 12) to (14) then, the preceding NP (i.e., NP_1) should have wide scope over the succeeding NP (i.e., NP_2). As mentioned earlier in this paper, Aoun and Li's analysis makes the same prediction as Huang's analysis for sentences with structure (14). According to Huang and Aoun & Li, NP_2 (i.e., y box) should take wide scope over NP_1 (i.e., x figure). Lee's analysis makes the opposite prediction.

Now consider the structural configuration given in (17) [=(23)]. In this structure, NP_1 c-commands NP_2, but not vice versa. According to Huang, NP_1 takes wide scope over NP_2. With regard to the notion of g-command, again, NP_1 and NP_2 g-command each other. In this case, since NP_1 precedes NP_2, according to Lee, NP_1 should have wide scope over NP_2. Considering the structure given in (17), a converging prediction may be derived via all three analyses mentioned.

As can be seen from the examples given in Table 1 and Table 2, besides the configurational factor, we also varied the types of quantified NPs occupying the two object positions in each sentence. We included two types of quantified NPs in this study: the universal Q-NP such as "every box" or "every figure" and the existential Q-NP such as "one box" or "one figure". In some sentences, the two quantified NPs were of the same type (e.g., sentences in Table 2); in other sentences, these two NPs were not of the same type (e.g., sentences in Table 1). Taking the order of the two quantified NPs into account, four possible combinations of these two types of quantified NPs were established: the "every-every" condition, the "every-one" condition, the "one-every" condition and the "one-one" condition. In order to facilitate comparisons among these conditions, we have included only one set of test sentences as examples here. However, in the real test conditions, three sets of test items were included. [One with the verb "hua (draw)" and the direct object NP "tuxin (figure)", one with the verb "xie (write)" and the direct object "suzi (number)", and the final set with the verb "tu (mark/color)" and the direct object "yanse (color)".] Addition of the ba-sentences yielded a total of 16 test items in each set and a total of 48 test items for each subject. The three sets of test items were randomly given to each subject.

One hundred and ninety-two children between the ages of 3 and 10, and

42 adults were tested. The child subjects were randomly sampled from preschools and elementary schools in Taipei Taiwan. The adult subjects were undergraduate students attending National Chengchi University in Taipei. The children were divided into seven age groups in one-year intervals (e.g., G1: 3-4...G7: 9-10) with at least 25 children in each group except the first two groups.

Let us first examine our adults' responses. The results concerning the eight types of quantificational constructions are summarized in Table 1 and Table 2. When adult subjects were asked to "draw one figure in every box" [e.g., (15)], about 77% of the time, they assigned wide scope (WS) reading to the existential Q-NP "one figure" and drew the same figure in different boxes. About 19% of the time, they assigned WS reading to "every box" and drew different figures in different boxes. This result, at first sight, seems to follow Lee's prediction but not the one provided by Huang or Aoun & Li. However, note that a WS reading for "every" does allow the response illustrated in (15a) where the same figure is drawn in each box. Nothing about the syntax or the scope assignment makes it necessary that a different figure be put in each box. And, in fact, Lee's analysis predicts that no instances of (15b) be found, so it remains a question why 19% exist. Thus it seems that the results given in (15a & b) are more consistent with Huang's or Aoun & Li's analysis than with Lee's.

Now, look at the result listed in (16). When adult subjects were asked to "draw every figure in one box", almost all of our subjects only assigned the WS reading to the existential Q-NP "one box" and drew all three figures in a certain box. This result, on the other hand, does follow Huang or Aoun & Li's analysis but not Lee's.

Let us examine the data listed in (18) and (19). When adult subjects received the instruction "In one box, draw every figure", with only very few exceptions, they assigned the WS reading to the existential Q-NP "one box" and drew all three figures in a certain box. This result is compatible with all three analyses provided by Huang, Lee and Aoun & Li, respectively. Now consider the data listed in (19). When adult subjects received the instruction "In every box, draw one figure", about 50% of the time they assigned WS reading to the universal Q-NP "every box" and drew different figures in different boxes. About 41% of the time, they assigned WS reading to the existential Q-NP "one figure" and drew the same figure in all three boxes. This result is compatible with all the three linguistic analyses under discussion because wide scope for the universal quantifier does not imply that there must be different figures chosen.

What preliminary conclusions can be drawn from the data just examined? The hypothesis of g-command and linear precedence (hereafter the linearity hypothesis), to a certain degree, was not confirmed by the data, while the c-command hypothesis was confirmed by the data. The experimental method seems to be valid. The question is why most of the adult responses in (15) had only one figure instead of three different ones. It seems possible that when more than one response is consistent with the syntactic analysis, the preferred response is affected by non-syntactic factors or performance considerations (as in "backward" coreference).

Let us examine the results of the sentences involving two universal Q-NPs [i.e., the every-every constructions listed in (21) and (24)] and those involving two existential Q-NPs [i.e., the one-one constructions listed in (22) and (25)]. The only correct interpretation for sentence (21) and (24) is to draw all three figures in each of the three boxes.

As indicated, about 93% of adult subjects gave the correct interpretation to these two constructions. When adult subjects were asked to draw one figure in one box, about 96% of the time they drew a certain figure in a certain box and left two figures unused and two boxes empty. When they received the instruction "in a box, draw a figure", about 76% of the time they drew a certain figure in a certain box with two figures unused and two boxes empty. About 18% of the time, they drew different figures in different boxes. In other words, they assigned the generic reading to sentence (25) and interpreted the sentence as the following: "for every x, if x=box, in x, draw one y, y=figure".

Children's responses to the eight types of quantificational constructions are illustrated in the eight figures given in Tables 1 & 2. As can be seen from the figure under (15), when children were asked to "draw one figure in every box", the WS reading was more frequently assigned to the existential Q-NP "one figure" than the universal Q-NP "every box" (excepting groups 1 & 2). The response pattern exhibited by children, older than 5, follows the same trend observed in adults. The response pattern exhibited by children younger than 5, on the other hand, does not follow the same trend observed in adults. It should be pointed out that, in the present study, a high portion of our young children tended to give only one particular response to all the test questions they had received. Therefore, the set of data obtained from children younger than 5 should be interpreted with caution.

When children were asked to "draw every figure in one box" (16), their response pattern, to a certain degree, seems to be different from the adults. Adults almost always assign wide scope to "one box", but even relatively old children (7 to 9) give almost as many responses with the 3 boxes involved as indicated in (16b). We speculate that the children might treat the PP in (14) as a sister node to NP_1, so that NP_1 and NP_2 c-command each other. Thus either responses [i.e., (16a) & (16b)] will be possible.

Let us consider the results illustrated in (18) and (19). As indicated in the figure under (18), when children received the instruction "in one box, draw every figure", most of the time, they assigned the WS reading to the existential Q-NP "one box" and drew all three figures in a particular box. Again, children exhibited a response pattern very similar to the adults' (excepting groups 1 & 2). When children received the instruction "in every box draw one figure", they assigned WS reading to the universal Q-NP "every box" more frequently than the existential Q-NP "one figure" (excepting G7). Our Group 7 children attributed the WS reading to the universal Q-NP almost as frequently as the existential Q-NP. This response pattern exhibited by children, once more, follows a similar trend observed in adults.

To summarize, if we look at the responses given by children older than 5 (i.e., our group 3 to group 7 children), a parallel between children's scope interpretation and adults' scope interpretation was found when constructions with two objects (an universal Q-NP and an existential Q-NP) were examined. The particular response distributions were somewhat different, but all the children's behaviors were consistent with the adult syntactic analysis except (16) "Draw every figure in one box." Here we speculated that the children did not have the same phrase-structure as the adults. [Note that the analysis given in (17) is not necessarily the only one. Here the PP could be attached higher up. However, there is no possibility that the children would attach the PP under V′ because complements in Chinese come on the right.]

Let us examine how Chinese children will interpret similar constructions with two universal or two existential Q-NPs. The results are given in Table 2. As mentioned earlier in this paper, the only correct interpretation for sentences involving two universal Q-NPs is to draw all three figures in each of the three boxes. However, as indicated in the figure under (21) and (24), children gave very few responses corresponding to this correct adult interpretation. In many cases, they drew a figure in a box and another figure in another box until there was no figures left and no boxes unused. Our child subjects seemed to know the concept of "every N" and tried to establish a relation between the members of the two sets of elements mentioned. However, instead of making one universal Q-NP enter the scope of another universal Q-NP, they assigned "sum of plurals" readings to (21) and (24). For example, a sum of plurals reading for (21) corresponds to the following statement "draw three figures in three boxes such that each of the figures is drawn and each of the boxes is drawn in." An alternative interpretation to this set of results is that children may produce this strikingly different result because of some kind of response set, namely, they did not want to use any figure more than one time. Our intuition is that this is an unlikely interpretation, especially given the older age at which children still produced this result. Obviously future research is necessary. However, if this response pattern is upheld, and is seen to be a result of children's syntactic knowledge (and not an artifact) then it seems that it is an important empirical discovery which calls out for theoretical explanation. It might be central to a discussion of the acquisition of operators in child language.

When child subjects were asked to draw one figure in one box, in most of the cases, they drew a certain figure in a certain box and left two figures unused and two boxes empty. When they received the instruction "in one box, draw one figure", the same response pattern was observed. They drew a certain figure in a certain box with two figures unused and two boxes empty. Similar to the adult subjects, in some cases our child subjects also assign the generic reading to sentences containing two existential Q-NPs. However, they did so to both sentence (22) and sentence (25), while adult subjects only assigned the generic reading to sentence (25) but not sentence (22). A fuller discussion and understanding of these and other results awaits further investigation. At any rate, we have provided evidence that children understand relative scope and have knowledge of the syntactic considerations which determine available scope readings.

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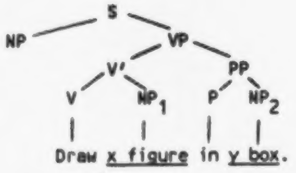
We would like to thank James Huang, Audrey Li, Barbara Lust and James Gair for their useful comments.

Table 1

The Test Sentences and the Results

(14)


S
NP
VP
V'
PP
V
NP1
P
NP2
Draw x figure in y box.

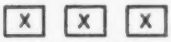
PREDICTIONS

Huang: y box has wide scope over x figure.
Lee: x figure has wide scope over y box.
Aoun & Li: y box has wide scope over x figure.

RESULTS

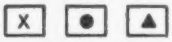
(15) Hua yige tuxin zai meige gezi li.
Draw one-CL figure at every-CL box inside
"Draw one figure in every box."

a.

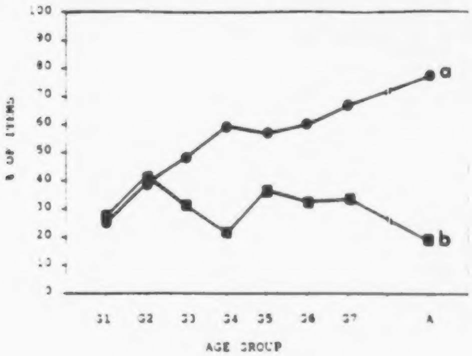


Adult: 76.98%

b.

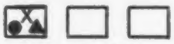


Adult: 19.05%



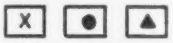
(16) Hua meige tuxin zai yige gezi li.
Draw every-CL figure at one-CL box inside
"Draw every figure in one box."

a.

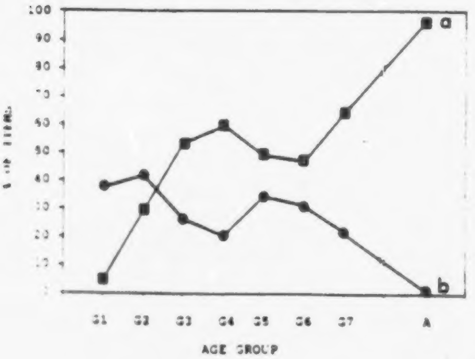


Adult: 96.03%

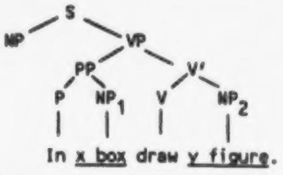
b.



Adult: 0.79%



(17)


S
NP
VP
PP
V'
P
NP1
V
NP2
In x box draw y figure.

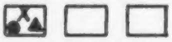
PREDICTIONS

Huang: x box has wide scope over y figure.
Lee: x box has wide scope over y figure.
Aoun & Li: x box has wide scope over y figure.

RESULTS

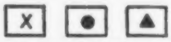
(18) Zai yige gezi li hua meige tuxin.
At one-CL box inside draw every-CL figure.
"In one box draw every figure."

a.

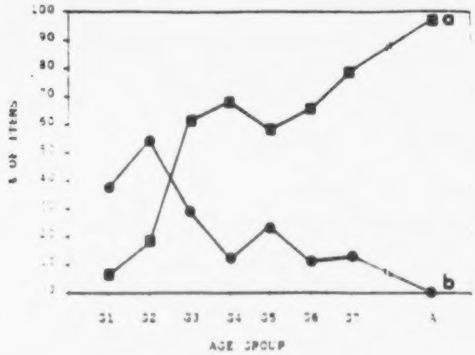


Adult: 96.83%

b.

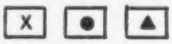


Adult: 0.00%



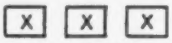
(19) Zai meige gezi li dou hua yige tuxin.
At every-CL box inside all draw one-CL figure
"In every box draw one figure."

a.



Adult: 50%

b.



Adult: 41.27%

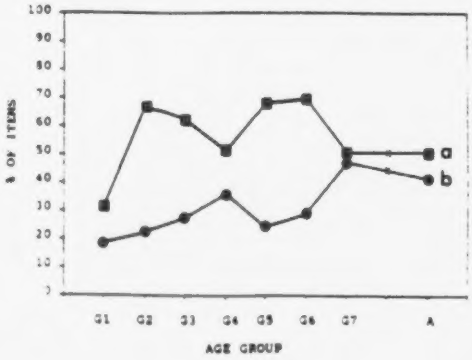
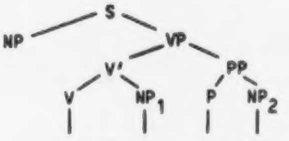


Table 2
The Test Sentences and the Results

(20)



Draw x figure in y box.

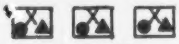
PREDICTIONS

Huang: y box has wide scope over x figure.
Lee: x figure has wide scope over y box.
Aoun & Li: y box has wide scope over x figure.

RESULTS

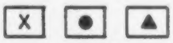
(21) Hua meige tuxin zai meige gezi li.
Draw every-CL figure at every-CL box inside
"Draw every figure in every box."

a.

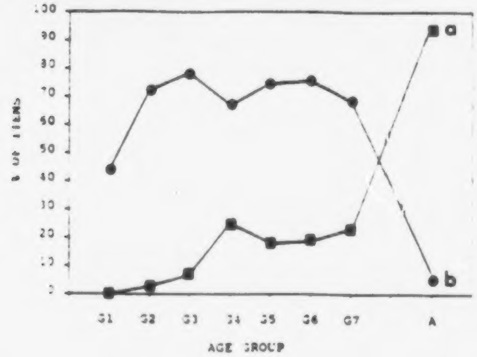


Adult: 93.65%

b.



Adult: 4.76%

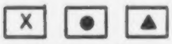


(22) Hua yige tuxin zai yige gezi li.
Draw one-CL figure at one-CL box inside
"Draw one figure in one box."

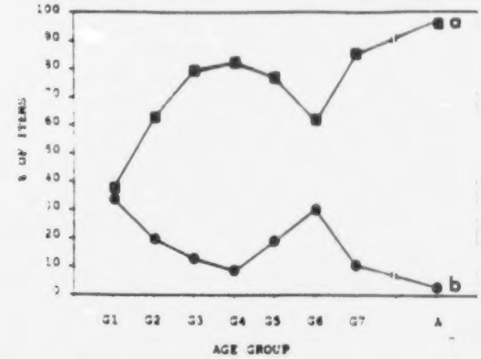
a.

Adult: 96.03%

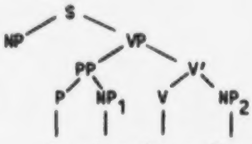
b.



Adult: 2.38%



(23)



In x box draw y figure.

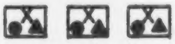
PREDICTIONS

Huang: x box has wide scope over y figure.
Lee: x box has wide scope over y figure.
Aoun & Li: x box has wide scope over y figure.

RESULTS

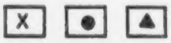
(24) Zai meige gezi li dou hua meige tuxin.
At every-CL box inside all draw every-CL figure
"In every box draw every figure."

a.

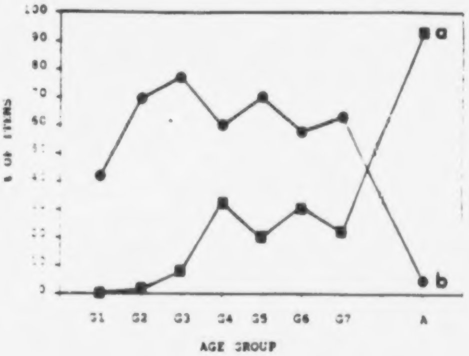


Adult: 92.86%

b.



Adult: 4.76%

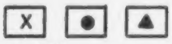


(25) Zai yige gezi li hua yige tuxin.
At one-CL box inside draw one-CL figure
"In one box draw one figure."

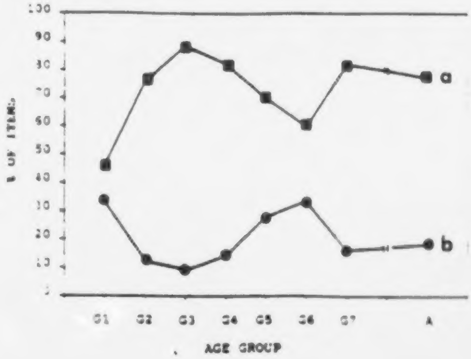
a.

Adult: 76.19%

b.



18.25%



Problems in the Acquisition of Grammatical Tone*

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Boston University

1. Introduction

The development of autosegmental phonology (e.g. Leben 1973, Williams 1976, Goldsmith 1976) represents one of the most important advances in the development of phonology since the generative insights of The Sound Pattern of English (SPE) (Chomsky & Halle 1968). Yet the field of acquisition has been slow to adopt and integrate new perspectives from theoretical phonology, much the same as it has been slow to adopt and apply theoretical insights in the area of syntax. The present study attempts to address this issue by developing an autosegmental account of the acquisition of grammatical tone in Sesotho, a southern Bantu language. While this work represents the first stages of on ongoing research project, it raises several theoretical questions that will hopefully serve as a model for future study in this area. In particular it addresses three questions: 1) When/how does the child figure out that Sesotho is a tonal, rather than an intonational, stress or accentual language? 2) How does the child acquire tonal rules? 3) When do children become aware of OCP effects?

2. The Prosodic Acquisition Problem

In order to address the Prosodic Acquisition Problem we need to have a model or theory of what prosodic systems look like. For the purposes of this paper I will assume a model of Lexical Phonology along the lines of that developed by Kiparsky (1982, 1985) and Mohanan (1982, 1986). A model of lexical phonology allows us, and presumably the child, to specify where and how pitch is assigned. Languages will differ to the extent that they assign pitch to various domains (i.e. morae, syllables, words) and at various parts of the grammar (i.e. stipulated underlyingly, assigned lexically and/or assigned postlexically), and to the extent that pitch assignment may interact with other linguistic phenomena such as stress.

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* Data collection for this work was supported by Fulbright-Hayes and Social Science Research Council (SSRC) grants. Data transcription and analysis has been supported by NSF Grant #BSN-8709938 and by the Social Science Research Council (SSRC). I would like to thank Nick Clements, Julie Croston, Charles Ferguson, Larry Hyman, Michael Kenstowicz, Paul Kiparsky, Chuck Kisseberth, Mark Johnson, Will Leben, K. P. Mohanan, Mpiko Ntsekhe, Bill Poser, Mpatliseng Ramaema, the Sesotho Tone Working Groups at the LSA Summer Institute at Stanford (1987) and at MIT (1988), and members of the Sesotho Tone Workshop at Boston University (1988) for providing stimulating discussion and assistance relating to this research.

The problem for the child is to figure out 1) whether the language s/he is learning is a lexical tonal (e.g. Chinese), stress/intonational (e.g. English), accentual (e.g. Japanese, some Bantu languages) or a grammatical tonal language (Sesotho and other Bantu languages), 2) what tonal rules apply and where they apply (in the lexical or postlexical component, and 3) if there are any OCP effects.

3. Acquisition of Sesotho Tone

The data for this study come from a monolingual Sesotho-speaking child whose spontaneous utterances during interactions with siblings, parents and grandparents were sampled at 2;1, 2;6 and 3;0 years.[1] Only High (´), Lowered High (+) and falling (^) tones are marked.[2] A subset of affirmative present tense utterances are considered here. The data are not intended to be statistically significant, but rather provide an indication of general tendencies in the child's developing prosodic system.

Sesotho word order is (S)V(O). This paper will focus on the verbal complex which is composed of the following morphemes:

(1) (S) SM-(T/A)-(OBJ)-V-(EXT)-M (O)[3]

In the following discussion I will assume an autosegmental analysis with separate segmental and tonal tiers. Though Sesotho can be analyzed as having only High (H) tones, with Low (L) tone as the default value (Kisseberth 1989), I will refer to both H and L tones for ease of reference.

4. A Tonal vs. Intonational, Stress or Accentual System

At 2;1 years the child most frequently has a HL (or H+) final pattern at the end of many utterances, but not necessarily at the end of medial clauses, as in (2).

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[1] Age is represented in years and months: 2;1 years = 2 years and 1 month.

[2] Studies of the acquisition of phonology have shown that that is a certain amount of individual variation in phonological development. We might therefore expect some individual variation in the types of tonal acquisition patterns exhibited by different children. However, the present study of one child will hopefully identify some of the issues. Analysis of data from a second child at the same ages is currently in progress.

[3] Lesotho orthography is adapted here, resulting in a broad phonetic transcription, though mid vowels follow the non-distinctive orthographic conventions. The second person singular subject marker *u*, is rendered here as *o* (phonetically identical to third person singular subject marker, except that third person is High tone). The present tense subject marker (SM) assumes an *-a* when the verb is final in the verb phrase. Gloss abbreviations are as follows: AGR=agreement marker, APL=applicative/benefactive, COP=copula, DEM=demonstrative pronoun, DIM=diminutive, EXT=verbal extension, M=mood, OBJ=object clitic, POSS=possessive, PN=independent pronoun, suffix, PREP=preposition, SM=subject marker, T/A=tense/aspect, WH=question word, 8=noun class 8, 2s=second person singular.

(2) 2;1 yrs. *ánká ké ená*
(ke-a-ńk-a+ ké e-na)
1sSM-PRES-take-M COP 9-DEM
'I'm taking (it), here it is'

However, he more accurately produces clause final HL by 2;6 years (3), and is even more consistent by 3 years, possibly indicating access to the syntax through prosodic cues.

(3) 2;6 yrs. *tél:a wa wakhutsanyáne*
(o-a-téll-a ó-mo-khútswa-nyáne)
2sSM-PRES-disrespect-M 1AGR-1SM-short-DIM
'you're disrespectful, you shorty'

While the child's productions at 2;1 years might be consistent with an intonational analysis, it appears that by 2;6 years he has learned the tonal rule of phrase final lowering.

Sesotho has a phonological rule of penultimate lengthening (=stress?) which is especially prominent at the end of clauses and which children fairly consistently produce by 2 years. If the child adopted a stress type of analysis, we would expect the lengthened syllables to be marked with a consistent tone pattern. We have noted above the frequency of a final HL pattern: We might hypothesize that this is evidence of a stress=tone analysis, however further evidence shows that this is not the case. Even where Sesotho would posit a HL final pattern, the child demonstrates inconsistency. Thus, while HL final patterns are very frequent in the child's speech, as well as in the input, the phenomena is not especially robust.

Clements & Goldsmith (1984:16) hypothesize that children learning Bantu languages might adopt an accentual (in the sense used in Clements & Goldsmith 1984) analysis as a strategy for facilitating factorization, or mapping between segmental and tonal tiers in a more linear fashion. While it is not clear exactly what kind of data would address this issue, a closer look at the child's tone on verbs is suggestive.

At 2;1 years, 73% of all verbs, most of them disyllabic, have a tonal pattern of HL in phrase final position, or HH in non-final position (i.e. when an object follows). The fact that so many of the verbs have a H tone on the first syllable might be consistent with an accentual analysis of the type proposed by Clements and Goldsmith (1984), where underlyingly a verb would be associated with a diacritic (*) which would then be interpreted as a High tone at a latter stage of the tonal derivation. But it is difficult to distinguish the effect of marking underlying representations with a diacritic rather than with a H tone itself (see also Pulleyblank 1986). On either analysis the important factor is that the child is treating most verbs in the same way. One would therefore have to look for other evidence, such as when/at what level, lexical tones are assigned in the child's grammar. A closer look at the child's productions shows that there is developmental trend toward distinguishing two groups of verbs; this is as shown in Table 1.

Lexical Tone (Verbs)						
	Total H	Surface		Total L	Surface	
Age (y;m)		H	%		L	%
2;1	32	26	**0.8**	20	**8**	**0.4**
2;6	32	26	**0.8**	31	**17**	**0.6**
3;0	8	6	**0.8**	8	**8**	**1.0**
High tone on first syllable of verbs with L SMs						

Table 1.

Thus, while verbs are more consistently marked as H at 2 years (4)-(5), they have been differentiate into H and L by 3 years (6)-(7).

(4) 2;1 yrs.
tea hána
(ke-a-ħán-a+)
1sSM-PRES-refuse-M
'I refuse'

(5) 2;1 yrs.
a-kúla
(o-a-kul-a)
2sSM-PRES-sick-M'
you are sick'

(6) 3;0 yrs.
o-ngóld́ lengolo?
(o-ngól-á le-ngólo)
2sSM-write-M 5-letter
'Are you writing a letter?'

(7) 3;0 yrs.
ke-kopa motoho
(ke-kop-a mo-tohó)
1sSM-ask-M 3-porridge
'I'm asking for porridge'

I suggest the there is ample evidence from the input for initially construing disyllabic L verbs as H (due to High Tone Spread from subject markers). It could well be that the child's initial hypothesis is that all verbs are lexical H toned. The appropriate underlying lexical tone of verbs would then be acquired gradually on a item by item basis within the lexicon, or until facility with other verbal melodies forced a reanalysis of lexical tones. Evidence for this proposal comes from the fact that certain high frequency verbs such as H toned *hana* 'refuse' and L toned *batla* 'want' are more consistently produced as such by 2;6 years than are other less frequent verbs (both in input as well as in the child's productions), and that lexical tones on verbs are largely in place by 3 years when morphological tone phenomena are being acquired.

We might then predict that the acquisition of tone on subject markers would either 1) parallel that found for verbs (i.e. all subject markers will be initially marked as H), or that 2) there will be an early and consistent distinction between H and L subject markers. Unlike with the more uniform marking of verbs as H, there is a more consistent (perhaps underlying?) tonal distinction between H and L subject markers around the age of 2, as shown in Table 2.

Lexical Tone (SMs)						
	Total H	Surface		Total L	Surface	
Age (y;m)		H	%	Low	L	%
2;1	13	11	0.8	49	40	0.8
2;6	21	18	0.9	53	44	0.8
3;0	13	6	0.5	16	13	0.8
SM=H/L - H & L Verbs						

Table 2.

There is 80% accuracy in the marking of both H and L toned subject markers at 2;1 years of age, as in (8) and (9) where the majority (78%) of the L toned subject markers at 2;1 years are the 1st person singular subject marker *ke* 'I', as in (9).

(8) 2;1 yrs.
é a kae?
(*ó-y-á kae?*)
1SM-go-M where
'where is s/he going?'

(9) 2;1 yrs.
a echá hápe
(*ke-ets-a hápe*)
1sSM-do-M again
'I'm doing (it) again'

The marking of L toned subject markers as L is consistent across time (10). This differs from the marking of H toned subject markers, where there is an actual decline in the appropriate tone marking by 3 years, as shown in (11).

(10) 3;0 yrs. *roná re-ngola káng?*
(*roná re-ngólá ká-ng?*)
1pPN 1pSM-write-M PREP-WH
'as for us, what are we going to write with?'

(11) 3;0 yrs. *a-chécha*
(*é-á-chech-a*)
9SM-PRES-reverse-M
'it's reversing'

I suggest that the decline in appropriate marking of H tone subject markers at 3 years may indicate that the child is beginning to deal with OCP effects (see § 6.).

Based on this preliminary data I suggest that Sesotho-speaking children are well aware by 2 years of age that their language is a grammatical tone language rather than a purely lexical tonal, stress/intonational, or even accentual language. I now turn to a discussion of tonal rules.

5. Iterative High Tone Spread

There is some evidence that children may have an early rule of Iterative High Tone Spread that persists until the morphological tone patterns (Melodies II and III) begin to be acquired around 3 years. Non-final disyllabic verbs are fairly consistently produced as HH (as in 6), and final trisyllabic verbs as HHL. While there are a few cases of High Tone Doubling (i.e. spreading only to the next syllable), as in (12), the norm seems to be iterative spreading, as in (13).

(12) 2;6 yrs. *séfojánu syá-bídíka kwána*
(sefófáne sé-a-bídík-a kwána)
airplane 7SM-PRES-revolve-M DEM
'the airplane is turning about over there'

(13) 2;6 yrs. *wená á máthélá má::::ne chabadímachetse kwana*
(wená o-math-el-a mâ:né Chabadímaketse kwána)
2sPN 2sSM-run-APL-M DEM Ch. DEM
'you're running WA:Y over there at
Chabadimaketse, far away'

There are few examples of four syllable verb stems in the spontaneous corpus. Further experimental study will have to determine the extent of the domain to which the child's rule of Iterative High Tone Spread applies.

Spreading on H tone subject markers is less clear; about half spread iteratively as in (13) above and (14), while others do not spread at all (15). In some cases the subject marker and tense/aspect marker have been collapsed into one syllable where one H tone is retained (16).

(14) 2;6 yrs.
á wélá nth(ò) éná...
(é-á-w-el-a ntho é-na...)
9SM-PRES-fall-APL-M 9thing 9-DEM
'it's falling, this thing...'

(15) 2;1 yrs.
á eta móda
(á-éts-a móna)
4SM-do-M DEM
'they're doing (it) here'

(16) 2;6 yrs. *á nyola kho:fú yéna*
(é-á-ṇyoloh-a khofú é-na)
9SM-PRES-ascend-M 9shovel 9-DEM
'it's ascending, this dumptruck'

Data from after 3 years, when children more consistently produce preverbal morphemes, will better be able to determine the extent of H tone spread on subject markers.

6. Obligatory Contour Principle (OCP) Effects

The Obligatory Contour Principle, or OCP prohibits two consecutive H tones from occurring on the tonal tier. Solutions to this problem range from conflation of two H's into one H, or alternatively, as found in Sesotho, delinking of one H and filling in with a default L, resulting in a HLH sequence on the tonal tier. Again, it is difficult from spontaneous productions to determine what the child's underlying representations might be. One might interpret some of the child's productions of Iterative High Tone Spread from subject markers as being application of the OCP, where two underlying H tones are conflated into one (17). However, it could also be that the child maintains two underlying H tones, thus violating the OCP; the natural production data render it difficult to distinguish the two analyses. There are some cases where a HLH pattern results, as in (18), but increasingly at 3 years the subject marker is produced as Low (19).

(17) 2;6 yrs.
kolóy yáká é ***thóthá*** *mokúlú:*
(kolóy yá-ká é-thoth-á bo-kúlúbe)
9car POSS-my 9SM-carry-M 14-horse dung
'my car is carrying horse dung'

(18) 2;6 yrs.
bá-kuká *mollo*
(bá-kuk-á mó-llo)
2SM-take-M 3-fire
'they're taking the flame'

(19) 3;0 yrs. ***a-chécha***
(é-á-chech-a)
9SM-PRES-reverse-M
'it's reversing'

I suggest that examples such as (19) may indicate an emerging awareness of a rule of High Tone Delinking, where underlying HH on the tonal tier becomes LH, perhaps a response to the OCP. The status of the OCP as a either a language universal, and therefore part of Universal Grammar (McCarthy 1986), or alternatively as a frequent, but language specific rule (Odden 1986, 1988) is as yet unresolved. It is hoped that further acquisition research may shed some light on the debate.

7. Conclusions

While the findings presented here are still preliminary, there appears to be evidence from spontaneous, natural productions that, at 2 years, the child knows that he is learning a grammatical tonal, rather than an stress/intonational, lexical tonal, or accentual language: There is no evidence of fixed tonal patterns that would imply an accentual analysis, nor a robust correspondence between the penultimate 'stressed' syllable and tone. While verbs are predominantly H, subject markers are distinguished by H/L contrasts. Secondly, an initial rule of Iterative High Tone Spread on verbs at 2 years gives rise to morphological tone rules, a rule of H Tone Deletion, and the lexical distinction of verb tones by 3 years. Finally, it would appear that the effects of OCP are learned much as other tonal rules, around the same time as the other verbal melody tone patterns begin to emerge.

While this study raises many more questions than it answers, it is hoped that it will stimulate future research not only on the acquisition of prosody, but on the acquisition of phonology as well.

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ACQUISITION OF GENITIVE AGENTS IN SAMOAN

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INTRODUCTION[1]

Developmental psycholinguists have been centrally interested in children's understanding and linguistic articulation of what Slobin (1985) calls 'manipulative activity scenes'- in which an agent performing some action affects some object. The concern of the present study is to extend our understanding of manipulative activity scenes and grammar beyond the articulation of major sentential constituents, more specifically to attend to ways in which children and adults grammaticalize manipulative activity scenes and perspectives within genitive constructions. Genitives have been primarily associated with the encoding of locative relationships such as possessor or goal (cf. Clark 1978; Lyons 1968). In Samoan, however, the genitive construction encodes a wide range of semantic roles including human agents (cf. Duranti & Ochs in press). That genitives, often called "possessives," do not simply or exclusively express relations of ownership has been noted by a number of scholars. Further, the link between genitives and agency has been reported in the acquisition literature (cf. Budwig 1985) and in typological studies of ergative languages, which note that in several languages, the genitive and ergative marker are the same. In Samoan the genitive marker and the ergative marker are not the same. Nonetheless there is a strong semantic link between the two. Our Samoan data represent to our knowledge both the most varied and the most recurrent use of genitive constructions for semantic roles other than possession. In this paper, we describe how Samoan adults use genitive constructions and compare adult strategies with those of four young children.

RESEARCH BACKGROUND

Samoan adults and children differ little in their expression of major sentential constituents and in the use of ergative case marking. Both prefer verb-initial utterances that contain only two major constituents: a verb or verb complex (VC) and a nominal argument. The NP expressed tends to be an absolutive NP, either Subjects of intransitive verbs or Objects of transitive verbs. The basic structure of utterances is thus:

(1) VC + Absolutive NP

Du Bois (1987) suggests that in all languages speaker-hearers tend to avoid expressing Agents as full lexical NPs. Speaker-hearers typically identify agents from referents expressed in prior discourse as absolutive consituents. Our examination of Samoan speech and writing, however, suggest that this presumption requires further thought. In Samoan, Agent participants may be expressed through genitive constructions within the absolutive NP. If we take a strictly syntactico-semantic definition, viz. Agents to be Subjects of transitive clauses, then our data largely confirm Du Bois' findings. On the other hand, if we widen our notion of Agent to include potential or factual agents in described, evoked, or presupposed events, regardless of the grammatical role of the phrase in which they are linguistically expressed, our data show different results.

In Samoan, the Absolutive NP of a two constituent utterance is often a complex NP that includes both an Affected Object (or Undergoer) as a Head Noun and an Agent or some other semantic role(s) in the Modifier. The syntax of these constructions is schematically represented in (2) (the angled brackets indicate an "either or" condition in the case of coreferentiality of Pro and NP):

(2) Verb Complex + [$_{NP}$ Art <Gen Pro> Head Noun <Gen NP>]

While genitive constructions in Samoan often express a relation of "possession," they express a wide range of other participant roles as well. Thus, in (3), the genitive phrase a Eki 'Eki's' refers to the person who prepared the food. Given that Eki is a young untitled male, it would be inappropriate, in a Samoan cultural context, to define the food he cooked for others as "belonging" to him. We consider this an example of genitive construction used to express an Agent:

(3) ("Pastor & Deacon")[2]

24 **fai le umu kalo a Eki ma lu'au**
do ART oven taro of Eki and palusami
(lit. make Eki's oven taro and palusami)
'Eki made baked taro and palusami'

Table 1 shows the distribution of different semantic roles in genitive phrases in adult speech. After Possessor and Body Part, Agent is one of the most common types of semantic roles expressed through genitive phrases. This finding opens up a whole series of questions about the definition and distribution of not only Agents but Actors, Experiencers and other semantic roles in a language like Samoan. Rather than the putatively "natural" or "universal" tendency for human participants to appear as Subjects, a tendency codified as

"Subjectivization" in Case Grammar (cf. Fillmore 1968; 1977; cf. also Kuno 1974) and "genitive ascention" in Relational Grammar (cf. Kimenyi 1980), Samoan seems to favor "Genitivization."

Table 1

Distribution of Semantic Roles in Genitives (Adult)*

Speakers:	Semantic Roles** Encoded:								
	POSS	**BEN**	**GL/LC**	**AG**	**ACT**	**EXP**	**PART**	**PNT**	**REL/KIN**
Women	.19 (27)	.14 (20)	.06 (9)	.16 (22)	.16 (23)	.06 (8)	.04 (6)	.01 (2)	.16 (22)
Men	.21 (17)	.12 (10)	.16 (13)	.19 (16)	.08 (7)	.06 (5)	.10 (8)	-	.23 (19)
TOTAL:	.20 (44)	.13 (30)	.10 (22)	.17 (38)	.13 (30)	.06 (13)	.06 (14)	.01 (2)	.23 (51)

*Each genitive construction may encode more than one semantic role. **POSS=possessor, BEN=benefactive, GL/LC=Goal/locative, AG=agent, ACT=actor, EXP=experiencer, PART=body part or other part/whole relation, PNT=patient, REL/KIN=social relationship, including kinship.

There are, however, semantico-pragmatic differences between the use of genitive vs. ergative NP's (Duranti & Ochs in press). In contrast to languages like English, where Subjects of transitive verbs can express a wide range of semantic roles (Keenan 1984), in Samoan, ergative NP's cover a restricted set of roles, typically human initiators of actions (cf. Cook 1988). Furthermore, ergative NP's may index or assign accountability to the participant role (cf. Duranti 1988). When the genitive phrase, as opposed to the ergative phrase, is used to refer to the putative agent, the focus is on the product or result of the action (if the verb is a potentially transitive verb) rather than on the party responsible. For this reason, genitive phrases seem to cover cases that in other languages might be expressed by passives or stative-like clauses, where the Patient or underlying Object acquires the syntactic role of Subject.

THE ACQUISITION OF GENITIVE CONSTRUCTIONS

Is complexity of the Absolutive NP something that unifies both adult and child language? Or is it here that adults and children's speech differs? In contrast to acquisition of clause structure, the acquisition of genitive construction shows a clear progression towards a broader range of semantic roles encoded and more complex head nouns.

Table 2
Semantic Roles in Genitive Constructions (Children)*

Child/ Age:	Semantic Roles Encoded:								
	POSS	**BEN**	**GL/LC**	**AG**	**ACT**	**EXP**	**PART**	**PNT**	**REL/KIN**
Kalavini (1;7)	-	-	-	-	-	-	-	-	-
(1;9)	-	-	-	-	-	-	-	-	-
(1;11)	1.0 (1)	-	-	-	-	-	-	-	-
(2;1)	.26 (10)	.68 (26)	.11 (4)	-	-	-	-	.03 (1)	-
TOTAL:	.29 (11)	.67 (26)	.10 (4)					.03 (1)	
Iakopo (2.1)	-	.67 (2)	-	-	-	-	-	.33 (1)	-
(2;8)	.45 (17)	.48 (20)	-	.03 (1)	.11 (4)	.08 (3)	.16 (6)	-	-
TOTAL:	.38 (17)	.49 (22)		.02 (1)	.09 (4)	.07 (3)	.13 (6)	.02 (1)	
Pesio (2;3)	.38 (11)	.35 (10)	.10 (3)	.04 (1)	-	-	.04 (1)	.14 (4)	.07 (2)
(2;10)	.73 (129)	.14 (24)	.07 (13)	.05 (8)	.02 (3)	.02 (4)	.06 (10)	.03 (5)	.01 (2)
TOTAL:	.68 (140)	.16 (34)	.08 (16)	.04 (9)	.02 (3)	.02 (4)	.05 (11)	.04 (9)	.02 (4)
Niulala (2;11)	.26 (20)	.54 (42)	.19 (15)	.03 (2)	.06 (5)	-	.13 (10)	.03 (2)	.01 (1)
(3;6)	.32 (14)	.23 (10)	.02 (1)	.09 (4)	.02 (1)	.05 (2)	.32 (14)	-	-
	.28 (34)	.43 (52)	.13 (16)	.05 (6)	.05 (6)	.02 (2)	.20 (24)	.02 (2)	.01 (1)
TOTAL:	.49 (202)	.33 (134)	.09 (36)	.04 (16)	.03 (13)	.02 (9)	.10 (41)	.03 (13)	.01 (5)

*Each genitive construction may encode more than one semantic role

Table 2 indicates the acquisition patterns of four children: Kalavini, Iakopo, Pesio, and Niulala. At an early point in acquisition, children use genitives primarily to express possessor and benefactor roles. The youngest child, Kalavini, does not encode genitive agents at all. The next youngest child, Iakopo also does not encode genitive agents in the earliest recording session and produces only 1 seven months later. Genitive Agents account for somewhat more of Pesio's and Niulala's genitive constructions, with the last session of Niulala at 3 years 6 months showing the greatest proportion at 9%. These data suggest a developmental pattern towards increased use of genitive NPs to encode Agent roles. In the corpus at hand genitive Agents characterize 4% of children's genitive constructions in comparison with 17% of adult genitive constructions.

Children's use of genitive constructions to express Agent roles is illustrated in (4) through (6) below:

(4) (Pesio, 2;10)

kusi::: -si:: lou aka?/
write -te your picture
(lit. 'draw -aw your picture?')
'are you drawing the picture?'

(5) (Niulala, 2;11)

masae le [ofu]vae [o] Fineaso
ripped the pants [of] Fineaso
'Fineaso ripped his pants'

(6) (Pesio, 2;10)

sa fai makou mea'ai
TA make our(excl) food
'(We) made food for ourselves.'

Genitive constructions of children and adults also differ in complexity of the head noun. In adult constructions where the modifier is an Agent, Actor, or Experiencer, the head noun is often a nominalization. In children's constructions, nominalizations are both rare and relatively late to be productively acquired. These patterns are expressed in Tables 3a and 3b.

Table 3a
Nominalized Head Nouns in Genitive Constructions (Adults)

Women:	Men:	TOTAL:
.13 (18)	.07 (6)	.11 (24)

Table 3b
Nominalized Head Nouns in Genitive Constructions (Children)

Kalavini		Iakopo		Pesio		Niulala	
(1;7)	-	(2;1)	-	(2;3)	-	(2;11)	.01 (1)
(1;9)	-	(2;8)	-	(2;10)	.01 (2)	(3;6)	.10 (4)
(1;11)	-						
(2;1)	-						
Total:	-		-		.01 (2)		.06 (7)

Tables 3a and 3b indicate that 11% of adult genitive constructions contain nominalizations, whereas only 2% of children's genitive constructions contain nominalizations. Table 3b indicates further that nominalized head nouns are absent or rare before children reach 3 and half years. To some extent this developmental pattern is linked to the late emergence of agents, actors and experiencers as genitive modifiers in children's speech.

CONCLUSIONS

The Samoan data presented here suggest that while Samoan adults and children both favor a clausal strategy of highlighting the affected object in a manipulative activity scene, Samoan children have difficulty exploiting the grammar of genitive noun phrases to encode agent roles as well. This pattern implies that children's two-constituent utterances differ from those produced by adults. In children's utterances, when an Agent is not encoded as a major sentential constituent, it is likely not to be encoded as a genitive modifier. That is, Agents are likely not to be found anywhere within the two-constituent clause. In interpreting children's speech, then, hearers must resort to one of the pragmatic strategies suggested by Du Bois, namely, locating Agent participants in the immediate setting or in previously mentioned absolutive NPs. In contrast, interpreters of adult speech may locate the agent participant inside the absolutive NP itself.

For all acquirers, the morpho-syntax of noun phrases is an important dimension of linguistic competence . In Samoan, however, and perhaps in other languages with a two-constituent bias, genitive constructions, nominalizations and other types of complex noun phrases lace even the most informal of conversations. In all kinds of Samoan talk, the absolutive NP in a two-constituent utterance is often heavy, loaded with information concerning human participants and the actions, states and locations that bind them. Speakers regularly produce such verb-initial utterances as 'Look at the stretching of that one' (Va'ai le fa'ake'e'ku'u a lele (PI-3:24)), 'Exceptional is the anger of the girl' (Ese fa'ali'i o lea kegikiki (PI-3:46)), 'Look at the actions of Sio' (Va'ai le fai'iga o Sio (PI-9:50)), 'Do you know about our going to New Zealand?' (E ke iloa 'oe le maa ooga i Giusila? (uaki: 377)). That such constructions are used so often and with such a variety of meanings suggests that the internal structure of the noun phrase is a particularly central domain of grammatical and conversational competence for Samoan children to acquire.

NOTES

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2) Abbreviations: AFF= affect particle; ART= article; DX= deictic particle; EMP= emphasis particle; INT= intensifier, sometimes with reflexive function; Prep= preposition; pro= clitic pronoun; TA= tense/aspect marker; PST=past.

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ACQUISITION OF NULL SUBJECTS AND CONTROL IN SOME SINHALA ADVERBIAL CLAUSES*

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General Introduction: This paper reports selected results from a large project concerned with the acquisition of empty categories(EC's) in Sinhala, an SOV language of the Indo-Aryan family, spoken in Sri Lanka. It concerns itself specifically with EC's which occur in a subset of adverbial clause types differing with regard to the kinds of null subjects they permit, including those which are obligatorily coindexed, i.e., 'control structures ' .

There have recently been a number of studies of the first language acquisition of 'control' structures in English (e.g., Cohen Sherman 1983, Cohen Sherman and Lust, 1987, 1988, Hsu, Cairns, Fiengo, 1985). To date, however, there has been little or no study of the acquisition of such structures in other languages, such as Sinhala. (See, however, Lust, Wakayama, Snyder, Mazuka and Oshima for a related study of Japanese acquisition; and Lust, Gair, Goss and Rodrigo 1987 for an earlier study of the acquisition of Sinhala EC's).

Typological Background: Sinhala is verb final and strongly, in fact virtually exclusively, left branching and right headed. Both complements and modifiers appear to the left of their heads, as shown in (1):

1 NP: laŋkaawe tee Sri Lanka-GEN tea -'Sri Lankan tea / tea of Sri Lanka'
gunəpaalə gænə kataawə Gunapala about story-DEF-'The story about Gunapala'

VP: tee biwwa tea drank- 'drank tea'
ikmənəTə diwwa quickly run-PAST-'ran quickly'

AP: huñgak rasə much tasty-'very tasty'

PP: laŋkaawə ætule Sri Lanka within-'in(side) Sri Lanka'

Recursive sentence embedding shares this left branching character. As exemplified in 2a and 2b, relative clauses appear always to the left of their heads, and finite adverbial subordinate clauses appear to the left of the main clause in unmarked order.

2. a. [[mamə gunəpaaləṭə dunnə] potə] [[[apee iskoole ugannənə]
I Gunapala-DAT gave-REL book our school-loc teach-REL
guruwərəyek liwwə] ekak]
teacher-INDEF wrote-REL one
'The book that I gave Gunapala was one written by a teacher who
teaches in our school'

b. [[iiye gedərə iñdəla ṭawməṭə yanəkoṭə] mamə loku nayek dækka]
yesterday house from town-DAT go-when I big cobra see-PAST
'I saw a big cobra when I was going from home to town yesterday'

Variant orders are, however, possible, generally with discourse-pragmatic effect. Thus, in a simple sentence , in addition to the unmarked SOV order, all possible orders of major constituents are acceptable with the proper intonation. This freedom extends also to subordinate clauses, including the -aamə and -la clauses with which we will be chiefly concerned.

Three further characteristics of Sinhala are extremely important here. First, finite verbs even if tensed fail to show agreement of any kind in the spoken varieties of the language[1], as shown in (3).

3. mamə/ oyaa/ eyaa/ api/ oyaala/ eyaala pansələṭə yanəwa/giyaa
I / you/ (s)he/ we/ you-PL/ they temple-DAT go-PRES/ go-PAST
'I/ you/ (s)he/ we/you-all/ they go/went to the temple'

Secondly, Sinhala is a language of the kind that might be called "super pro-drop", i.e., allowing EC in all argument positions,governed or ungoverned (except for object of postposition)(cf. Sumangala 1988). (4a) illustrates this for simple sentences; (4b) for complex. Thus, EC 's in Sinhala are widely determined by pragmatic context or discourse context for ambiguity resolution.

Thirdly, although lexical pronouns (e.g., eyaa '(s)he', etc.) and lexical anaphors/reflexives (e.g., taman/tamun'self') do exist in Sinhala, their appearance is far less common than that of null pronouns and is related to intentions of contrast, emphasis, or ambiguity resolution. (cf. Gair, 1970). Comparison with English translations in (4) will illustrate this.

4. a. TicketAgent : mennə noonage ṭikət-ekə
here lady-GEN ticket-DEF
'Here is your ticket (madam).'

Customer: Ø Ø Ø dennə
Ø Ø Ø give-INF
'Give (me) (the ticket)'

b. Ø maTə enəkoṭə Ø okkomə kaala iwəray
Ø I-DAT come-when Ø all eaten finished
'By the time Ø came to me, all(food) was eaten and finished'
or 'By the time it/they came to me, all(everybody) had finished eating'

As current linguistic theory would predict, however, while Sinhala empty categories are prolific and often pragmatically (non-grammatically) determined, their distribution in Sinhala is grammatically constrained, and their interpretation is grammatically differentiated. For example, an empty pronoun may not c-command its antecedent, (5), and co-reference with a c-commanding antecedent in a local domain is not possible with a coreferential interpretation(6) .

5. Ø$_{*i/j}$ gunəpaaləge$_i$ ammaṭə kæmətiy Ø gunapala-GEN mother-DAT like-
'He$_{*i/j}$ likes Gunapala's$_i$ mother.'

6. gunəpaalə$_i$ Ø$_{*i/j}$ kannaaḍiye dækka Gunapala Ø mirror-LOC saw
'Gunapala$_i$ saw him$_j$ / *himself$_i$ in the mirror.'

One effect of the combination of lack of agreement, relatively free word order, and the wide distribution of empty categories is the severe attenuation of surface signals accompanying different empty categories. in Sinhala This might be expected to heighten the problem of first language acquisition , to the degree that this acquisition depends on such signals,. As we shall see, this problem is even further compounded in the case of one set of adverbial clause structures.

The-la Conjunctive Participle: Sinhala shares with many other languages of South Asia the existence of a conjunctive participle[2] commonly cited as an important areal feature (Emeneau 1956 and much subsequent work...see particularly Masica 1976). The form fulfilling this function in Sinhala is the -la participle, as illustrated in (7) The sense is commonly, though not necessarily, temporal, with the action of the embedded clause preceding that of the main one and commonly linked to it in some fashion.[3]

7. mamə gedarə gihilla kææmə kææwa
I home go-la food eat-PAST
'I went home and ate.'

The embedded la clause in 7 is in its unmarked position preceding the remainder of $\bar{\bar{V}}$ (VP), and is clearly within the minimal dominating S ($\bar{I}$). This is shown by a number of characteristics, such as inclusion in the scope of negation of the main verb, which we will not pursue here, but it is perhaps illustrated most dramatically by the possibility of sentences like (8a), in which the subject is in the nominative case, as required by the main verb diwwa 'ran' although the embedded -la participle æhila (æhenəwa 'hear') would require the dative, as shown in (8b)[4]

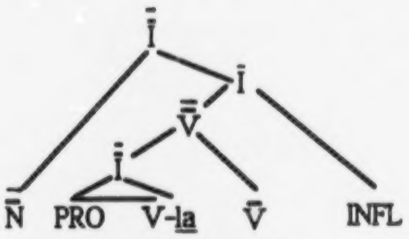
8. a. mamə saddəyak æhila diwwa I-NOM sound-INDEF hear-la run-PAST
'I heard a sound and ran'
b. maţə saddəyak æhuna I-DAT sound-INDEF hear-PAST
'I heard a sound.'

A crucial characteristic of -la clauses in the conjunctive function is obligatory coreferentiality between main and -la clause subjects as in (9a); i.e, they are control structures. Their control properties include the fact that they do not allow an overt NP, as in (9b).

9. a. $[_S$mamə$_i$ $[_{VP}[_S\ Ø_{i,*j}$ gedərə gihilla] kææmə kææwa $_{VP}]_S]$
I home go-la food eat-PAST
'I went home and ate.'
b. * $[_S$mamə $[_{VP}\ [_S$ Kalyani gedərə gihilla $_S]$ kææmə kææwa $_{VP}]_S]$
I Kalyani home go-la food eat-PA
'Kalyani went home and I ate'

We thus hypothesize that the basic structure for (7 and 9a) is as in (10)[5].Here the EC subject in the -la clause occurs within a nonfinite clause; it is c-commanded in a basic ''control' configuration (cf. Huang, 1989).

10.



CONJUNCTIVE -la

-aamə Adverbials: The EC in the conjunctive -la structure can be contrasted with that which occurs in a finite tensed adjunct subordinate clause, such as -the aamə 'when/after' clauses illustrated in (11). The -aamə form is made by adding that affix to the past tense adjectival form of the verb, the chief use of which is to form relative clauses as exemplified in (2) earlier. The adjectival form with -aamə is always past tense. Hence from dunnə 'gave (relativizing) is formed dunnaamə [6]. The sense is prior temporal "when", with differences from the similar use of -la that need not concern us here.

The -aamə construction easily involves the lexical expression of two separate subjects, as shown by (11a). Coreference is not required of a null subject, as in (11b). (A lexical pronoun may replace an EC in an -aamə construction, as in (11c) although a lexical pronoun in this case, as in many cases in Sinhala, tends to favor a non-coreferential reading.).

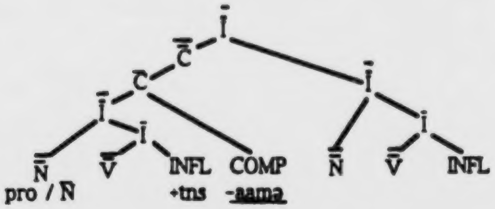
11a. mahattəya aawaamə mamə wæḍə kərannaŋ
gentleman come-aamə I work do-OPT
' I will work when (after) the gentleman comes.'

b. gunəpaalə$_i$ gaməṭə giyaamə Ø$_{i,j}$ gañgee næææwa.
Gunapala village-DAT go-aamə Ø river-LOC bathe-PAST
'When (after) Gunapala$_i$ went to the village (he$_{i,j}$ bathed in the river)

c. gunəpaalə$_i$ gaməṭə giyaamə eyaa $_{i,j}$ gañgee næææwa.
Gunapala village-DAT go(when) he/she river-LOC bathe-PAST
When (after) Gunapala$_i$ went to the village he$_{i,j}$ bathed in the river)

Given these characteristics of -aamə clauses, especially their non-control properties, we assume that they are adjuncts outside the minimal S, and that their subjects are not c-commanded in a control domain by the main clause subject, as in (12).

12. -aamə CLAUSES



We may now ask whether the child acquiring Sinhala knows the subtle differences between the EC's in -la and -aamə constructions and if so, what is the nature of the development of this knowledge? We have already noted the paucity of surface cues such as agreement, fixed constituent order and narrowly restricted distribution of EC's. One obvious possibility would invoke the subordinate morphology itself; i.e. the co-occurrence of different EC's with those affixes. However, this possibility is confounded by the lack of one-to one co-occurrence between -la and subject EC type. This is a function of the fact that Sinhala -la has other, non-conjunctive uses, which we will briefly describe.

Absolutive and Finite -la: A structure with -la may occur productively as a finite sentence, as in (13), and such sentences are by no means uncommon .(Note that 13c. shows both conjunctive and finite -la.).

13.a. mahattəya kantooruwəṭə gihilla. gentleman-NOM office-DAT go-la-
'He(hon.) has gone to the office.'

b. gunəpaalə mee wæḍə okkomə iwərəkərəla Gunapala-NOM this work all finish-la-
'Gunapala has finished all this work.'

c. kalageḍiyə meeseŋ wæṭila kæḍila water jug-NOM table-ABL fall-la break-la-
'The water jug has fallen off the table and broken.'

Furthermore, -la also occurs in an 'absolutive' construction. This is a subordinate structure, but it allows a lexical subject and shows none of the syntactic reflexes of a control structure. Non-coreference between subjects is not only allowed, but common, as in (14).

14a. amma gaməṭə gihilla, mamə seerəmə gedərə wæḍə kərannə oonə
mother village-DAT go-la I-NOM all house work do necessary
'With Mother gone to the village, I have to do all the housework.'

b. loku mahattayaṭa asəniipə welaa, mehee kaurut wæḍə kəranne nææ
big boss-DAT sick get-made-la here everybody work do NEG
'With the big boss sick, no one here is working.'

On theory-internal grounds, we assume that the -la clause in (14) reflects an underlying adjunct structure like the -aamə clause in (12), and not like the control -la structure in (10). Thus in (14a and b), the -la clauses are outside the minimal S containing the main verb, and their subjects are not c-commanded by the main verb subject.

The relevant properties of the three-la constructions are compared with each other and with -aamə in the table in (15)

15. SUBJECT PROPERTIES OF -la AND -aamə

	-la			-aamə
	Control (Conjunctive)	Noncontrol (Absolutive)	Independent (Finite)	
Obligatory Subject Coreference	+	–	–	–
No Possible Overt Subject	+	–	–	–
C-commanded by Main Subject	+	–	n.a	–

As (15) shows, -aamə patterns with the absolutive and finite -la in relation to the type of subjects it permits, though it is never used as the main verb in independent sentences. Thus, the problem of the non-congruence of morphology with nominal type is rendered even more complex. The learner must deal with four structures, of which three involve the same verbal morphology, and the control structure involving -la is not morphologically distinct from the other two la structures, which pattern with -aamə in terms of the kind of subjects allowed (and for the absolutive one, in control properties).

The Acquisition Problem : Given the lack of straightforward surface cues in Sinhala, we can hypothesize that only abstract syntactic structure, presumably configurational differences, can account for this differentiation of EC's in adverbial structures. Critically, Sinhala does not allow the child to depend solely on surface cues of morphology, as the foregoing has made clear. For the child acquiring Sinhala, then, only a sensitivity to such structural differences could account for their differentiation of EC's in this set of adverbial types. Critically, if the child acquiring Sinhalese is found to differentiate not only the EC's in the control -la and the -aamə constructions, but also the different types of -la, where no morphology is available, then we have a powerful argument for such sensitivity. In the remainder of this paper we will adduce both experimental and natural speech evidence for this 'structure-dependence' in early acquisition. A strong theory of Universal Grammar would predict that the child was equipped with such principles of 'structure dependence',(Chomsky 1986), and recent work has argued that children evidence such principles continuously in early stages of first language acquisition in other domains of anaphora (Lust, 1986, 1987).

The Acquisition Evidence: (a) Natural Speech. We have begun to study the natural speech of 74 children acquiring Sinhala as a first language, from 2 years, zero months to four years, zero months, with a mean age of 3,01, divided into four 6-month age groups. Each speech sample had a mean of 133 utterances and was collected by a native speaker in village homes or schools in the Kadawatha area of Sri Lanka. These analyses revealed a total of 438 utterances with various -la constructions, rising from a mean of 3.5 per child in the youngest age group to 10.5 in the oldest age group. In contrast, only 47 utterances with -aamə were found, remaining at a low mean rate of use over development, i.e., .07 in the youngest group, .84 in the oldest. Most interestingly, however, from the earliest age group, all three types of -la construction were evidenced, as table 16 exemplifies. The control type 'conjunctive' -la is productive at all age levels.

16. EXAMPLES FROM CHILDREN'S NATURAL SPEECH: DIFFERENT USES OF -la

(S#; AGE; Utt#)

Group 1: (1) conjunctive: mee, gaumak æñdəla innəwa 105; 2.00;149)
look, frock wear-la be(animate)-PRES -
Look, she is wearing a dress

(2) absolutive: nangi-t kaar-ekee nægəla yanəwa nangi-t ekkə (105;2.00;67)
little sister car-LOC enter-la go-PRES little sister-also with -
Little sister is going in the car with the little sister'

(3) finite: oon, amma genælla, nee ? (109;2.04;101)
there, mother bring-la, TAG -
'There, mother has brought it, hasn't she?'

Group 2:(4) conjunctive:: budiyanakoṭə maduruwo ævilla kanəwa (212;2.11;115)
sleep-when mosquitoes come-la bite-PRES-
'When I sleep mosquitoes come and bite me'

(5) absolutive: bakti-gitə gihilla aawa añḍə-beree (209;2.07;102)
'bhakti'-song-PL go-la come-PAST (añḍə)-drums
'Bhakti songs passed and the (añḍə) drums appeared'

(6) finite beḷṭ ekə kæḍila (211;2.11;5)
belt-one break-la
'The belt is broken'

Group 3:(7) conjunctive: api mee paak ekəṭə gihilla meekə eləwanəwa nee?
we this park-DEF-DAT go-la this one drive-PRES (317;3.01;57)
'We will go to that park and drive it, won't we'

(8) absolutive: ekkan ævilla, amma innəwa gedərə (306;3.04;62)
bring-la mother be(animate)-PRES home
Having been brought, mother is at home'

(9) finite: araka-t perailla (308;3.01;9)
that one-also overturn-la
'That one, too, has been overturned'

Group 4: (10) conjunctive: akki ævilla aait yanəwa (401;3.08;88)
big-sister come-la again go-PRES
'Big sister came and is going back'

(12) absolutive: peṭṭiyakə daala tibbe meekə (413; 4.00;25)
box-INDEF-LOC put-la be-PAST-FOC this-one
'(Someone)having put (it) in a box, this(-it) remained'

(13) finite: ewunge amma ævilla (405;3.08;99)
they-GEN mother come-la '
'Their mother has come'

The Acquisition Evidence: (b)Experimental Data. Although the observed productivity in natural speech does suggest both an early knowledge of the Sinhala control structure, and a differentiation of closely related adverbial structures, the natural speech data alone do not unambiguously identify the factors which children are consulting in differentiating these structures and their EC.'s To more precisely test the nature of children's knowledge, we have conducted a series of experiments to evaluate the specific factors which may be involved in the child's representation of these structures.

The Comprehension Test. In one of these studies, we tested 169 Sri Lankan children from 2 to 6 years of age (mean 4,8) acquiring Sinhalese, on a set of 16 experimental sentences in a standardized 'act out' test of comprehension. Half of these involved a -la construction' ; half involved an -aamə construction, as exemplified in the table in (1 7). All involved an EC in subject position of one clause. Each of these sentences was varied in design according to two syntactic factors, as the table suggests. Branching Direction (whether the adverbial clause was preposed (LB) or postposed(RB)); and Proform Direction (whether EC followed(forward) or preceded(backward) the subject name in the sentence). Finally, 70 of these children received the experimental sentences with an initial 'pragmatic lead'(PL) to the name in the sentence. For example, sentence 1 in (17) was preceded by a sentence, similar to "Now I am going to tell you a little story about the monkey".

17

-la EXPERIMENTAL SENTENCES: ACTOUT TASK

Forward Left

1. wañdura keselgeḍiyə ahulala Ø atə wanənəwa
monkey banana (having) picked -up Ø hand waves
When the monkey picked up the banana, Ø waves the(his) hand.

2. koṭiya bas-ekə peralala Ø rawumak duwənəwa
tiger bus-the (having) knocked-down Ø circle runs
When the tiger knocked down the bus, Ø runs in a circle.

Forward Right

3. wañdura naṭənəwa Ø keselgeḍiyə wiisikərala
monkey dances Ø banana (having) thrown
The monkey dances when Ø threw the banana.

4. gemba pinumak gahanəwa Ø ṭopiyə pahurugaala
frog somersaults Ø toffee (having) pawed
The frog somersaults when Ø pawed the toffee.

Backward Left

5. Ø boole pahurugaala puusa kakulə dikkərənəwa
Ø ball (having) pawed cat leg stretches
When Ø pawed the ball, the cat stretches the(his) leg.

6. Ø keselgeḍiyə bimədaala gemba pinumgahanəwa
Ø banana (having) dropped frog somersaults
When Ø dropped the banana, the frog somersaults.

Backward Right

7. Ø rawumak duwənəwa puusa bas-ekə atəərala
Ø circle run cat bus-the (having) dropped
Ø runs in a circle when the cat dropped the bus.

8. Ø kakulə ussənəwa balla ṭopiyə wiisikərala
Ø leg raises dog toffee (having) thrown
Ø raises the(his) leg when the dog threw the toffee.

-aamə EXPERIMENTAL SENTENCES: ACTOUT TASK

Forward Left

9. wañdura boole ahuləpuwaamə Ø appuḍigahanəva
monkey ball pick-up(when) Ø hand -claps
When the monkey picked up the ball, Ø claps the(his) hands.

10. gemba bas-ekə adəpuwaamə Ø muunə atullənəwa
frog bus-the pull(when) Ø face rubs
When the frog pulled the bus, Ø rubs the(his) face.

Forward Right

11. wañdura nonḍigahanəva Ø bas-ekə alləpuwaamə
monkey limps Ø bus-the touch(when)
The monkey limps when Ø touched the bus.'

12. balla oluwə hollənəwa Ø galə paagəpuwaamə
dog head shakes Ø stone step-on(when)
The dog shakes the(his) head when Ø steps on the stone.

Backward Left

13. Ø bas-ekə ahuləpuwaamə puusa uḍə paninəwa
Ø bus-the pick-up(when) cat up jumps
When Ø picked up the bus, the cat jumps up.

14. Ø boole roolkarəpuwaamə koṭiya pinumgahanəwa
Ø ball roll(when) tiger somersaults
When Ø rolled the ball, the tiger somersaults.

Backward Right

15. Ø nonḍigahanəwa aliya galə wiisikərəpuwaamə
Ø limps elephant stone throw(when)
Ø limps when the elephant threw the stone.

16. Ø uḍə paninəwa balla galə tallukarəpuwaamə
Ø up jumps dog stone push(when)
Ø jumps up when the dog pushed the stone.

This design allowed us to test the following hypotheses regarding children's knowledge of -la and -aamə strucures:

i. If children do distinguish -la structures as 'control' structures in distinction from the -aamə adjunct structures, then they should assign significantly more coreference in their interpretation of the -la structures , which involve obligatory coreference, than in their interpretation of the -aamə structures. They should assign significantly more disjoint reference responses to the -aamə structures, which involve a free EC, than to the -la structures. They should also allow the pragmatic lead to influence their interpretation of the EC in the case of the 'free EC' in the -aamə clause significantly more than in the controlled EC in the -la clause.

ii. In particular, if children distinguish -la and -aamə sentence types in terms of their abstract representation, as in 10 and 12, then children should differentiate the -la sentences according to the factors we varied experimentally.

Results: Analyses of results by standardized scoring criteria included the following:

i. We consider first the main effects, computed by ANOVA, on amount of children's judgements of coreference(CRJ) between the EC in the sentence and the name. Children made significantly more coreference judgements when responding to a sentence with -la than to a sentence with -aamə when the -la and -aamə sentences were analyzed as a total set (F(1,95)=7.98, p=.006). Overall, children computed a mean number of 1.20 coreference judgements (CRJ) with -la; 1.06 with -aamə type sentences. (Score range =0-2). A higher amount of CRJ on la was consistent over development. They made significantly more disjoint reference judgements (DRJ) when responding to a sentence with -aamə than with -la (F 1,95=10.47, p=.002) (-aamə type .08; -la .02.)

The factor of Pragmatic lead (PL) significantly affected CRJ on both -la and -aamə overall. However, analyses of interactions among the factors we varied showed that in the case of -la, the effects of PL were more limited .

ii. Children did differentiate the -la structures according to the experimental factors manipulated. For example, the la sentences 1 and 2 had the highest amount of CRJ(.1.51, i.e., about 75% of the data,), of all conditions for either 'la' or 'aamə'. The corresponding sentences with 'aamə' on table .17, i.e, 9 and 10, had less CRJ (1.19)..There was no significant effect of PL on the paradigm control -la sentences 1 and 2 (1.56 vs 1.51 with and without PL respectively.); although there was a significant effect on -la structures overall (F(1,161)=8.90,p=.003), as there was for -aamə overall (F(1,161)=12.98,p=.0004).).

The high CRJ values for the ("Forward Left") sentences 1 and 2 (on table 17) actually corroborate our basic hypothesis here in a serendipitous way that was not entirely anticipated under the original design. These sentences were designed under the assumption that they could and would reflect EC's as shown on the table; that is, that the overt NP subject would form part of a-la clause, outside of the main clause, analogous to the -aamə sentences. That is, they were expected to be interpreted as in 18a and b, with a tree structure parallel to the -aamə clause in 12.

18 a. [wañdura$_i$ keselgedi ahuləla] Ø$_{i/j}$ atə wanənəwa
[monkey$_i$ banana pickup-la] Ø$_{i/j}$ hand waves

b. [koṭiya$_i$ bas-ekə perələla] Ø$_{i/j}$ rawumak duwənəwa
[tiger bus knockdown-la] Ø$_{i/j}$ circle runs

However, these sentences 1 and 2 are also susceptible to interpretation as in (19a and b), i.e. as the canonical 'control structure' of the tree representation in (10), and they map onto it in a straightforward fashion.

19. a. wan̆dura$_i$ [Ø$_i$ keselgedi ahuləla] atə wanənəwa
monkey$_i$ [Ø$_i$ banana pickup-la] hand waves

b. koṭiya$_i$ [Ø$_i$ bas-ekə perələla] rawumak duwənəwa
tiger$_i$ [Ø$_i$ bus knockdown-la] circle runs

Note that the surface linear order of constituents here is the one that occurs commonly in the children's natural speech for conjunctive structures where there is an overt main subject (viz. the relevant examples in the natural speech table (16)). In both natural speech, and experimentally, then, the children appear to have strongly favored that 'control' mapping , accounting for the fact that this category of sentences shows the highest CRJ and resistance to the effects of pragmatic context.. Contrast this with the ("backward right") sentences 7 and 8 in (17). In these, not only is the 'la' clause extraposed out of the canonical control domain, but the presence of an overt nominal in the postposed -la clause blocks the control 'la' interpretation, and forces the absolutive one. These show the lowest CRJ of any of the types tested (.82). The corresponding -aamə sentences, 15 and 16, showed higher CRJ (1.01). than 7 and 8, signifying once again the child's distinction between -la and -aamə clauses.

Conclusions: In conclusion, these experimental results suggest a continuous 'stucture-dependence' in children's early hypotheses about the prolific EC's in Sinhala., including those involved in 'control structures'. As we have shown, Sinhala EC's are not differentiated by surface cues such as verb morphology, or surface agreement. Thus, the fact that children did distinguish the interpretation of EC's in the full set of adverbial forms we tested appears to reflect sensitivity to the abstract structure of these forms. Critically, in -la sentences 1 and 2, which were susceptible to the canonical control structure, children took the option for a control interpretation. They clearly did not assimilate these to the adjunct -aamə sentences.

In terms of linguistic theory, the full set of results appears consistent with a "generalized control theory" such as proposed by Huang (1989), wherein EC's are significantly differentiated by the configuration in which they appear; although this remains a direction for future research. In terms of first language acquisition, these results cohere with previous results on Sinhala acquisition derived through an experimental test of production (elicited imitation), i.e., Lust, Gair, Goss and Rodrigo 1987. More generally, they cohere with results attained on English acquisition of control by Cohen Sherman 1983, 1987, Cohen Sherman and Lust, 1988, 1986 which provide evidence for continuous structure-dependence in the child acquiring English control structures. They also cohere with results attained from experimental study of Japanese acquisition of adverbial structures (Lust, Wakayama, Snyder, Mazuka and Oshima, 1987). The crucial issue these results raise is: if it is abstract structure that is consulted critically by children in the differentiation of EC's, how is this knowledge determined, i.e., how is it mapped correctly to various surface structures? What principles does the child use to determine what constitutes a 'paradigm control stucture' as opposed to an adjunct structure? The experimental results reported above in Sinhala begin to identify the type of structural factors that were consulted in this mapping and point the direction for future research. in these areas.

FOOTNOTES

[*] We acknowledge with love and respect the intensely precise assistance of Serena Tennakoon on the data collection and data analyses involved in the results reported in this paper. Her death is an unspeakable personal and professional loss to Sri Lankan studies.

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[1] Sinhala is a diglossic language (Gair 1968), having grammatically and functionally distinct Literary and Colloquial varieties. Literary Sinhala does have a system of subject-verb agreement, which raises other problems for later language acquisition (Gair, in preparation); these properties of Sinhala are not dealt with here, since we are confining ourselves strictly to the natural acquisition of Colloquial Sinhala by children.

[2] This is sometimes referred to as an "absolutive" participle, a usage we avoid , especially since it invites confusion with the absolutive use of -la to be discussed later.

[3] One frequent sense is similar to that of the English verb phrase conjoinings that do not obey the conjoined structure constraint (i.e. do not impose subjacency), of the kind noted by Ross (1967): "What did you go to the store and buy?", and they commonly translate such structures. There are other definable senses as well, such as a kind of manner one: mamə miris daala kəeməə hæduvə 'I chillies put-la food made'-' I made the food(by) putting in chillies.'

[4] A sentence with a dative case subject, but otherwise identical to (8a) is in fact possible, as in (8c):

8c. maţə saddəyak æhila diwwa.
I-DAT sound-INDEF hear-la ran
'I heard a sound and ran.'

However, there is a clear difference in that (8c) will allow a direct case nominal, even though coreferent with the dative one, to occur as subject of the main clause. Thus (8d) is grammatical, (though unlikely except in special circumstances, given the general sparseness in pronoun use). However, (8e) where the embedded subject is spelled out, is impossible:

8d. maţə saddəyak æhila mamə diwwa
I-DAT sound-INDEF hear-la I-NOM ran
'I heard a sound and ran'

e. *mamə maţə saddəyak æhila diwwa.
I-NOM I-DAT sound-INDEF hear-la ran
'I heard a sound and ran.'

[5] We have assumed an $\bar{I}$ in SPEC $\bar{V}$ structure, but that does not affect our argument. The crucial point is that the clause is within IP(-S) and clearly c-commanded by the higher, co-referential, subject.

[6] For some speakers it is formed by adding it to the relativizing form based on the participial stem, hence diipusamə, but this is a simple variant not affecting the distribution and does not matter for our purposes. -samə is historically a contracted form of hamə (probably ultimately < Sanskrit samaya 'time'), and in careful speech one may still hear dunnə hamə or diipu hamə.

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A Sensitive Period for the Acquisition of Complex Morphology: Evidence from American Sign Language

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Recent investigations by Mayberry, Fischer, and Hatfield (1983) and Newport (1984), into the use of American Sign Language (ASL) by deaf persons with deaf parents (native signers) and those with hearing parents (late signers), suggest that late signers are using signs as unanalyzed wholes. Newport (1984) provides striking evidence of this from a study conducted by Ted Supalla and herself. Results indicated that neither age, nor the number of years of signing was predictive of significant effects. In contrast, the age at which the deaf person first learned to sign (native, early, or late) was a significant factor. The signs of these late learners did not incorporate all of the required inflections.

Newport asks why it is that older deaf children or adolescents learning ASL for the first time (early and late signers), are not as adept at learning the morphological complexities of ASL as are young native signers. After all, physiologically an older child should have more available memory and better cognitive processing abilities than a younger child. One possibility is that an older child's ability to see the gestalt of a sign may actually impair his/her ability to see the parts. In other words, late signers may be using the lexicon, or sign, as their basic linguistic unit of analysis.

If we assume that a young infant has limited memory and/or cognitive processing abilities, it follows that the infant native signer may only be able to comprehend components of a sign, such as its handshape or movement, and may be unable to retain very many features of a sign in mind at any one time. If Newport's suggestion is correct, and the late signers are using a holistic unit of analysis, then we should see very different patterns of development in major morphological subsystems for native and non-native signers.

As native signers mature, the internal morphological complexity of verbs in ASL increases (Newport and Meier, 1985). This development can be expected to continue past 5 and possibly as late as 10. If the late signers are using a holistic approach, then the morphological complexity of the sign should remain constant across age. If the late signers are using an analytical approach, we could expect the development of the various subsystems to parallel that of the native signers. This study investigated the morphological complexity of verbs used in a narrative by native and late signing deaf children.

Method:

To investigate this possibility, the acquisition of three independent, yet simultaneously produced morphological systems in ASL were examined. These include; the linguistic use of space, the use of classifiers, and inflections for aspect. Unlike spoken languages, ASL incorporates additional information into a sign via simultaneously produced layers rather than sequentially produced units. Variations in the use of space (where the beginning and end points of a sign are), the use of classifiers (handshapes and linguistic use of the body) or in aspectual inflections (changes in movement) all contribute unique information to a sign.

Thirty deaf children with severe or profound prelingual hearing losses and no secondary handicapping conditions, and two deaf native signing adults participated in this study. Four groups of native signers (ages 3, 5, 7, and 9), and two groups of late signers (ages 5 and 9) all attended the California School for the Deaf in Fremont. Each group of children consisted of five subjects. Unfortunately, there were not enough late signers to include 3 and 7 year olds. All native signers have deaf parents and have been exposed to ASL since birth and all late signers have hearing parents and no other deaf family members. The late signers were first introduced to some kind of sign language (usually a signed English system) between the ages of 2 and 4.

The subjects were videotaped either at school or at home. As one of several psycholinguistic tasks, the subjects were asked to first look through, then sign, the story from the picture book "Frog, Where Are You?" by Mercer Mayer (New York, Dial Press, 1969). They were allowed to look at the pictures while telling the story. All videotapes were transcribed and coded by the researcher (a hearing native signer) and an ASL researcher (a deaf native signer).

Seven verbs were chosen for this analysis. The ability to use morphologically complex verbs has been shown to be a reliable indicator of fluency in ASL (Supalla, 1982). The seven verbs chosen were some of the most common verbs in the story and were chosen because they were used by all age groups and because they represent different kinds of verbs in ASL.

Comparing the performance of native and late signers was difficult because of the small number of subjects (five) per group. To equalize each subject's contribution to the data, scores were averaged within verbs for each subject. Each subject had a maximum of seven scores, one for each verb. This procedure also controls for individual differences in story length. With five subjects per cell, there was a maximum of thirty-five data points per group. It was not uncommon for subjects to not use one of the seven verbs at all in their rendition of the story. This was coded as an omission. Omissions were excluded from my calculations, which made statistical computations difficult because of unequal sample size between age groups and the small numbers overall. Consequently, significance testing was not performed on these data. Instead, frequencies of occurrence of particular forms are outlined.

Results and Discussion:

In this study there are striking differences between native and late signers on all measures relating to the internal complexity of the analyzed verbs. These measures include the use of space, classifier use, inflections for aspect, and the general internal complexity of a sign. Measures unrelated to the internal complexity of a sign do not show the same kind of qualitative differences. For example, a simple count of the number of signs used by the subjects reveals very similar patterns of development. The average number of signs in a story increases with age for native and late signers. This measure does not take into account the number of morphemes per sign, only the total number of discrete signs in a story.

Development of Spatial Reference:

The four spatial inflections examined in this study include signs that are; uninflected, inflected to the book, inflected to an arbitrary point, inflected to an arbitrary point with a previous reference. If the development of each type of spatial inflection is parallel for native and late signers, then it can be posited that overall development of spatial reference is also parallel.

The course of development for uninflected forms is very interesting. These results, shown in Figure 1, indicate that while 3 year olds use more uninflected forms of the analyzed verbs than the other forms, the frequency of uninflected forms increases at ages 5 and 7, then decreases dramatically at 9. Adults rarely use the uniflected form of the verb.

Insert Figure 1 Here

The inflecting of a verb to a book is not mentioned in previous literature and therefore may not have been examined in previous research. The native signing 3 year olds use this form extensively while the older native signers do not use it at all. In this relatively immature use of spatial reference, it seems that the book, and specific pictures in the book, are being used as a physically present object, to which these verbs are being inflected.

Native signing 9 year olds are establishing spatial loci for various referents and are beginning to maintain those loci over several utterances. This is reflected in their increased number of verbs inflected to an arbitrary point both with and without previous reference. Between age 9 and adulthood, however, the verbs with previous reference surpass those without previous reference. Adults are establishing and using locations in the signing space on regular basis at this point.

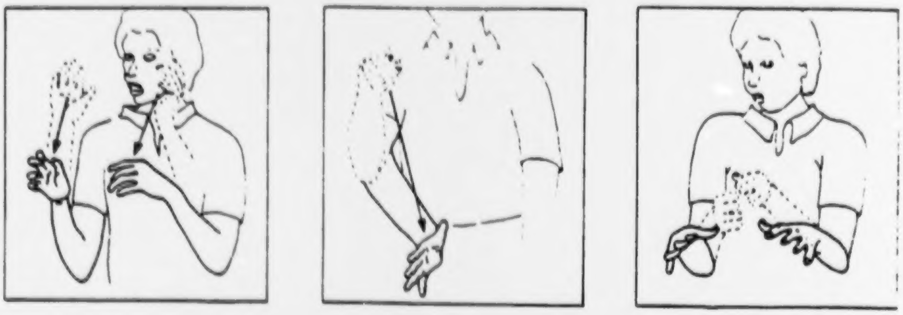
The development of spatial inflections for late signers shown in Figure 2, is very different than that for native signers. Contrary to the native signers, the frequency of uninflected signs for late signers increases between ages 5 and 9 as the frequency of signs inflected to an arbitrary point decreases.

Insert Figure 2 Here

For the 5 year old late signers the high frequency of verbs inflected to an arbitrary point is due to the random placement of signs in the signing space. This interpretation of the data is supported by the corresponding low frequency of verbs inflected to an arbitrary point with previous reference. This could be due to chance alone. The inflection of a verb to an arbitrary point with a previous reference is an indication that the signer is beginning to use space linguistically. There is no evidence that the 5 year old late signers are using the signing space linguistically in this narrative. This is not to claim that late signers at this age would not understand or use some simpler uses of space such as verb agreement for present referents (e.g., I-GIVE-YOU or YOU-GIVE-ME). The developmental patterns of spatial reference by native and late signers are viewed as evidence of qualitative differences in development.

Illustrations 1 and 2 are examples of a native signer and a late signer commenting on the same picture. The dog is jumping on the tree, the beehive falls and shatters followed by the bees emerging from the beehive, now on the ground. Illustration 1 shows a 9 year old native signer signing the sentence:

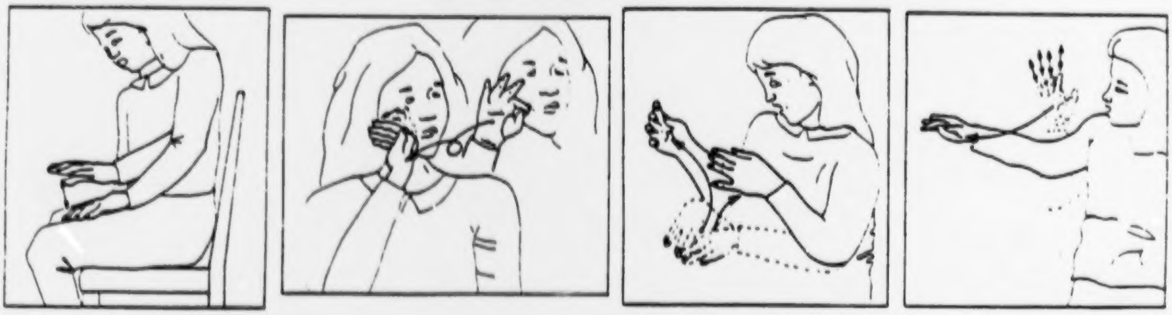
Illustration 1



DOG-PUSH-IT SMALL-ROUND-THING-FALLS-DOWN SMALL-ROUND-THING-SHATTERS

This sentence uses the downward direction of the falling in the second sign. It is very clear that a small round thing, in this case the beehive, is falling down. In contrast, Illustration 2 depicts a very different version of the same scene. Here a 9 year old late signer signs:

Illustration 2



DOG BEE OPEN MANY-SMALL-THINGS-FLY

This sentence uses no spatial reference at all. We don't know what opened, why it opened, or how the act of opening is connected to the dog and the bees.

Development of Classifier Use:

A second feature of ASL acquisition analyzed here is the use of classifiers to mark secondary objects and grammatical relations. Again, there are different patterns of development for native and late signers.

Results shown in Figure 3 indicate an overall increase in the number of classifiers used by native signers as they mature. Late signers, however, actually show a decrease in the frequency of classifier use.

Insert Figure 3 Here

Illustrations 1 and 2 also show the differences between the analytic use of classifiers and the use of unanalyzed forms. The sentence shown in Illustration 1 contains several classifiers. In the first sign the boy uses his body as a body classifier for the dog pushing the beehive. The second sign uses a C-shape handshape as a Size and Shape Specifier (SASS) classifier for a small round thing falling. The last sign also uses a SASS classifier and shows the beehive shattering.

In contrast, the sentence in Illustration 2 contains no explicit reference to the beehive. Only the last sign could be a classifier sign but even this is in doubt. Earlier in this girl's rendition of the story she asked the test administrator what was happening in the picture. She responded:

BEE MANY-SMALL-THINGS-FLY

It appears as if this late signer simply copied this second sign as a whole. In support of this interpretation is her use of the sign OPEN (open a box), which indicates that she is not analyzing the components of this verb. The frozen form of the verb OPEN is taken from the prototypical action of opening a small cardboard box. Each hand is a SASS classifier for a wide-flat flap moving from a flat closed to an upright open position. This subject used this form to refer to the opening of a window and the opening of the beehive after it fell. The verb OPEN has presumably not yet been analyzed by this subject.

Development of Aspectual Inflections:

The overall frequencies of aspectual inflections for the different groups shown in Figure 5 indicate that for the native signers, aspectual inflections are acquired relatively early. The performance of the late signers is very different than that of the native signers. Late signers do not seem to be paying attention to the variations in the sign's movement, or if they are, they are not incorporating that variation. The sharp drop in frequency of aspectual inflections by 9 year old late signers would again indicate a qualitative difference in linguistic processing between the native and late signers.

Insert Figure 4 Here

Development of the Internal Complexity of a Sign:

The development of the three morphological subsystems can be better understood if we consider how they are integrated in the sign itself. The morphemes included in this measure of internal complexity are: 1) the verb itself, 2) any classifiers used to mark a subject, object, or grammatical relation, and 3) any aspectual inflections articulated simultaneously with the verb. Figure 5 shows how the number of morphemes within a verb increases for the native signers, but not for the late signers.

Insert Figure 5 Here

Development of Contextual Complexity:

It is assumed that the complexity of the utterance is a reflection of cognitive development. The sentence in which the analyzed verb occurred was coded as: 1) a label (FALL), 2) a description (BOY FALL or FALL WATER), 3) a relationship (BOY FALL WATER or JAR-OVER-HEAD), or 4) a causal relationship (DEER STOP, BOY FALL). Figure 6 reveals parallel patterns of development for both groups with late signers exhibiting an approximate two year delay.

Insert Figure 6 Here

Conclusions

This pattern of development indicates that native signers use the morpheme as their basic linguistic unit of analysis, while late signers use the lexical item itself. This conclusion is supported by the finding that the number of morphemes per sign increases with age for the native signers, but not for the late signers. This difference between native and late signers does not exist at the sentence level. Both native and late signers use increasingly complex sentences as they mature. The interesting finding here is that late signers show cognitive development without morphological development.

These findings support Newport's claims that late signers treat signs as gestalts, rather than as independent, simultaneously produced systems. Late signers, being first exposed to signs when they are cognitively more developed, are able to see the sign as a whole. They then use the sign, rather than the morpheme, as their basic linguistic unit of analysis, thus impairing later morphological development.

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Figure 1

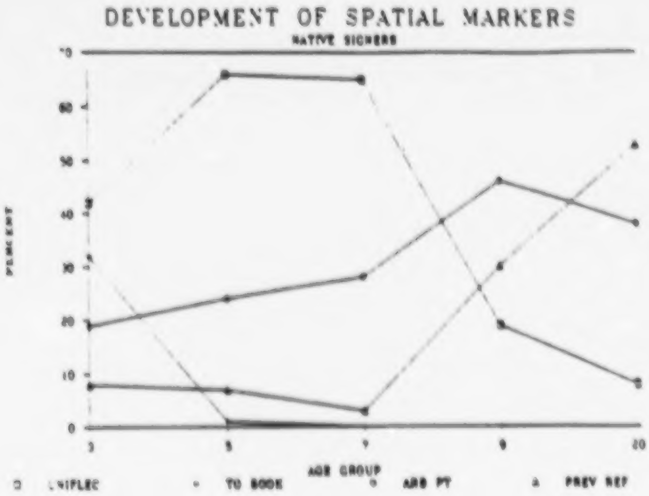


Figure 2

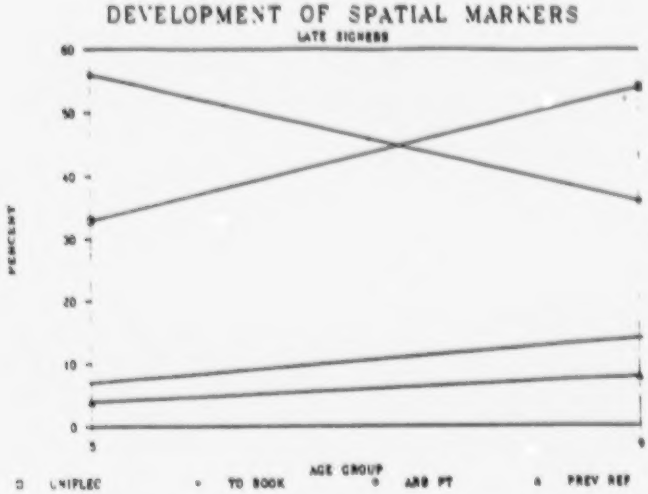


Figure 3

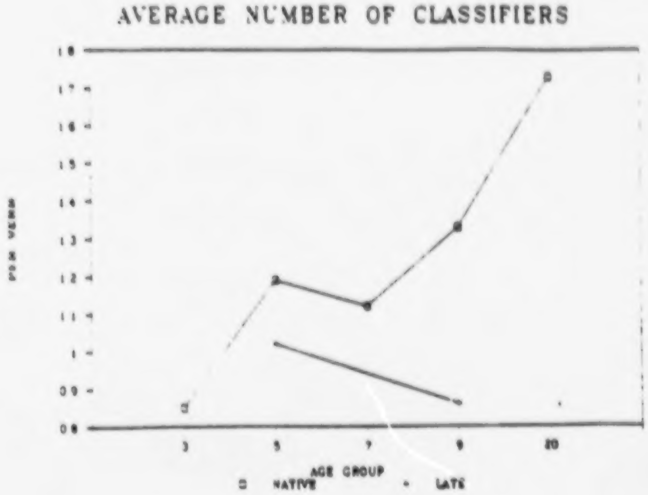


Figure 4

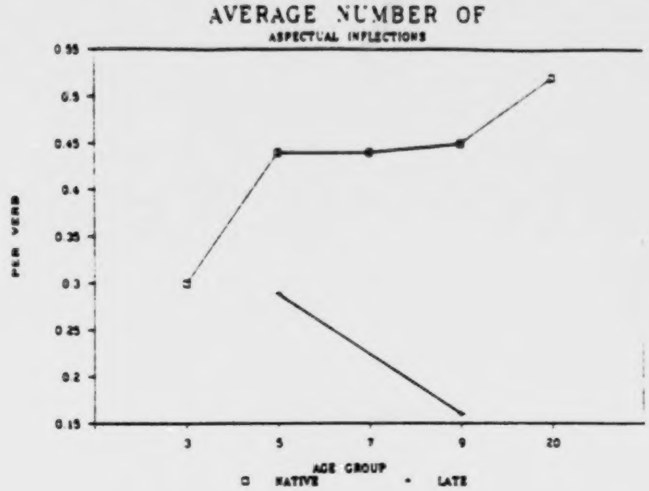


Figure 5

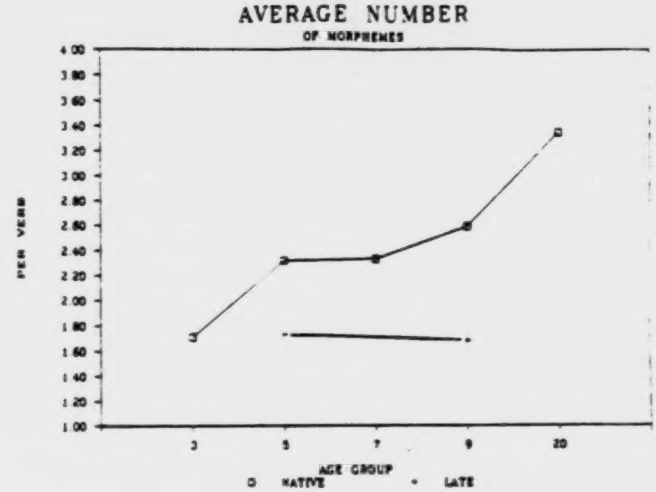
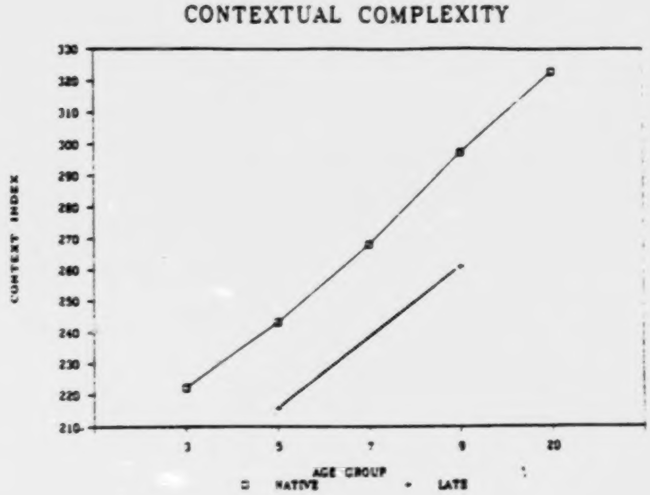


Figure 6



THE FUNCTION OF THE OBLIGATORY CONTOUR PRINCIPLE IN ENGLISH: EVIDENCE FROM CHILD LANGUAGE*

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1. Introduction.

Brown's (1973) Stage II is characterized by the onset of the acquisition of inflectional morphology in English. Research on this stage has focussed on the order of acquisition both across morphemes and within morphemes. Here, I am concerned with the latter, with the acquisition of inflectional allomorphy. In particular, I focus on the [əz] allomorph of the plural because its acquisition bears directly on a contentious issue in recent phonological literature, the role of the Obligatory Contour Principle (OCP). My goal is to determine how the OCP operates in English, both in acquisition and in adult grammar.

I attempt to account for the stages in the acquisition of the [əz] allomorph as well as for the late appearance of [əz] vis-à-vis the other plural allomorphs. Most of the discussion centres on a type of error which I term 'gemination' where the child simply adds [s] or [z] directly to the root, yielding [horss] and [rozz], for instance, as the plurals of horse and rose respectively. I suggest a parametric account of the operation of the OCP to explain both gemination and the other stages in the acquisition of the [əz] allomorph.

2. Plural allomorphy in English.

The English plural has three phonologically conditioned allomorphs, a syllabic allomorph, [əz], and two nonsyllabic allomorphs, [z] and [s]. Their distribution is as in (1).

(1) Distribution of English plural allomorphs
    [z] after sonorants: e.g. dome, tail, shoe
    [z] after voiced nonsibilant obstruents: e.g. bed, dog, sieve
    [s] after voiceless nonsibilant obstruents: e.g. cap, lake, bath
    [əz] after sibilants: e.g. horse, dish, judge

Crucially, the syllabic allomorph [əz] appears after roots ending in sibilants. The OCP is responsible for the intrusive [ə]; it functions to break up sequences of (nearly) identical segments which would otherwise end up adjacent to one another.

3. The Obligatory Contour Principle.

I will briefly discuss those aspects of the phonological theory I am assuming which are relevant to the formulation of the OCP. In current nonlinear theory, phonological representations are multiplanar. Segments (actually bundles of hierarchically organized features) are linked to a central core consisting of skeletal slots. The slots, noted by Xs, indicate the number of segments in the representation. See (2).

(2) Nonlinear representation of <u>stitch</u>

```
     X X X  X     skeletal tier
     | | | / \
     s t ɪ t š    segmental/melodic tier
```

Affricates are represented as two segmental matrices linked to one skeletal slot (Clements & Keyser 1983). In (2), [tš] consists of one segmental matrix which is identical to that for [t] and another which is identical to that for [š]. It is thus not surprising that [tš] and [dž] pattern with [š] and [ž] in the plural.

The OCP is given in (3). It disallows sequences of identical elements on the segmental tier where 'element' refers to whole segments or features, depending on the language. It is claimed to be universal.

(3) Obligatory Contour Principle (McCarthy 1986:208)
At the melodic level, adjacent identical elements are prohibited.

Languages may allow adjacent identical elements, but the OCP requires that they share melodic structure at the point where the violation would occur. For example, if a language allows geminates, the OCP requires that <u>all</u> melodic material be shared. The representation must be as in (4)A and not as in (4)B.

(4)A. Licit representation of pp   B. Illicit representation of pp

```
     X   X                                *X  X
      \ /                                  |  |
       p                                   p  p
```

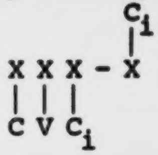
The OCP is not simply representational in nature. For instance, it has long been known that geminates cannot be split by rules of epenthesis (Kenstowicz & Pyle 1973). The OCP disallows epenthesis into geminates as the association lines between the skeletal tier and the segmental tier would necessarily cross; this is prohibited by the theory of nonlinear phonology (Goldsmith 1976, inter alia). See (5).

(5) Epenthesis between pp

```
    *X X X  or *X X X
      \X         X/
       p ə       ə p
```

Before discussing how the OCP operates across morphemes boundaries, I will briefly review McCarthy's (1979, 1986) theory of morpheme concatenation as much of the literature on the OCP assumes it. McCarthy proposes the Morphemic Plane Hypothesis where each morpheme enters the representation with its segmental material on a separate plane. Skeletal material of different morphemes is aligned from the start. The representation of the bimorphemic sequence CVC_i-C_i is as in (6).

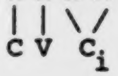
(6) Biplanar representation



Although the final consonants in (6) are identical, they are not adjacent at this stage in the derivation and so are not yet subject to the OCP. However, all segmental material is ultimately aligned by a process called plane conflation.

In languages which allow geminates, in conformity with the OCP, the two identical segmental melodies are automatically merged as a result of plane conflation. The post plane-conflation representation of CVC$_i$-C$_i$ is then as in (7). What started out as a bimorphemic form in (6) is now indistinguishable from the corresponding monomorphemic form, CVC$_i$C$_i$.

(7) Post plane-conflation representation



In languages which do not allow geminates, how the OCP operates across morpheme boundaries is a contentious issue. Some researchers (e.g. McCarthy 1986; see also Borowsky 1987) believe the OCP functions to block the application of any rule which will create a violation. Others (e.g. Yip 1988) argue that the OCP may also function to trigger the application of rules which repair violations.

In (8), the blocking versus triggering functions of the OCP are illustrated for the English plural. (I have ignored the assumptions of the Morphemic Plane Hypothesis for now.) Crucially, in the blocking analysis, the underlying representation of the plural morpheme must be /əz/ as in (8)A. The [ə] deletes everywhere except where an OCP violation would occur. Thus, [ə] deletes in roads but not in roses. In the triggering analysis in (8)B, the underlying representation of the plural morpheme is assumed to be /z/; epenthesis occurs whenever there is an OCP violation. Thus, epenthesis occurs in roses but not in roads.

(8)A. OCP as blocker

	/roz-əz/	/rod-əz/
[ə] del	—	↓ Ø
	[rozəz]	[rodz]

B. OCP as trigger

	/roz-z/	/rod-z/
[ə] epen	↓ ə	—
	[rozəz]	[rodz]

I will argue below that the acquisition data lead to the conclusion that in English the OCP operates to trigger [ə] epenthesis rather than to block [ə] deletion.

4. Acquisition of the [əz] allomorph of the plural.

Much research has focussed on the acquisition of the plural beginning with Berko's (1958) seminal paper on the subject. She found that the [əz] allomorph is the most difficult for children. This finding has been confirmed by many other researchers, both for data collected naturally and for data collected experimentally (e.g. Anisfeld & Tucker 1967, Bryant & Anisfeld 1969, Brown 1973, Ervin 1964, Miller & Ervin 1964, Hecht 1983).

A morphological explanation has often been provided for the late acquisition of [əz] (e.g. Berko 1958, Baker & Derwing 1982, see also Bybee & Slobin 1982). The child initially assumes sibilant-final roots are already inflected and, as a result, adds no further inflection. Berko states (p. 173): "a final sibilant makes a word plural". Despite the fact that this analysis intuitively seems correct, it is problematic for two reasons. One, the formal implication is that sibilant-final roots have two allomorphs. *Rose*, for instance, would have one allomorph /roz/ and another allomorph /ro/ to which the plural /z/ would be added. To my knowledge, no languages have morphological structures of this kind. If we assume following Pinker (1984) that the child's grammar at every stage is a possible adult grammar, this is not a possible analysis. Two, this explanation incorrectly predicts that deletion is the only strategy the child will entertain to avoid the [əz] allomorph.

Virtually all researchers who have looked at the acquisition of the [əz] allomorph have commented on the prevalence of deletion. A few have also mentioned the existence of another strategy, gemination. As mentioned in section 1, in gemination, the child adds [s] or [z] directly to the root, yielding [rozz] as the plural of *rose*, for instance. I use the term 'gemination' loosely since the clusters which result may not always be completely identical (cf. the plurals of roots which end in palatal sibilants).

Although gemination does not appear to be very common, the fact that it exists must be accounted for because it results in a violation of English phonotactic constraints; English does not allow tauto-syllabic long consonants. Actually, gemination may be more common than has been documented. Some examples may have been misanalysed as deletion since English speakers tend to hear identical consonant clusters as short.

I have extracted examples of gemination from Berko (1958) and Hecht (1983). The sibilant-final roots used in the two studies are provided in (9); those which underwent gemination are indicated.

(9) Examples of gemination strategy
A. Berko (1958).
Subjects: 80 children, 4-7 years of age
Sibilant-final nonsense words: *tass* [taes] *nizz* [nɪz]
gutch [gʌtš] *kazh* [kaež]
Sibilant-final real words: *glass*
Examples of gemination: 10% of subjects - plural of *gutch*
5% of subjects - plural of *kazh*

B. Hecht (1983).
Subjects: 42 children, 2;10-5;10 years of age
Sibilant-final nonsense words: dass [daes] fooz [fuz]
push [p^š] gutch [g^tš]
Sibilant-final real words: bus rose bush watch
Examples of gemination: 10% of subjects - plural of gutch
2% of subjects - plural of watch
2% of subjects - plurals of all sibilant-final words

Both Berko and Hecht discuss the gemination strategy as an individual response pattern and so do not present much information on it across subjects. Hecht does mention that five of her forty-two subjects used the strategy some of the time; all of her subjects also used deletion. Those who used gemination tended to be her younger subjects (three three-year-olds, one four-year-old, and one five-year old), suggesting that gemination may be the first stage in the acquisition of [əz]. Deletion would then be the second stage. This order of acquisition can only be hypothesized from the cross-sectional data; clearly, a longitudinal study looking at both gemination and deletion is in order.

5. Phonological account of the late acquisiton of [əz].

I provide a phonological explanation for the late acquisition of the [əz] allomorph, one that is rooted in the operation of the OCP. Recall that McCarthy argues that the OCP's only function is to block the application of rules which create violations. By blocking such rules rather than allowing them to apply and subsequently patching up the resultant violations, McCarthy claims that the OCP operates as a passive constraint. It is crucial for his analysis that the underlying representation of the plural morpheme be /əz/. If it were simply /z/, he would incorrectly predict that that the plural of rose was [rozz], as illustrated in (10).

(10) Derivation of *[rozz] à la McCarthy

```
        A. Pre plane-conflation      B. Post plane-conflation
                     z
                     |
             X X X - X                     X X X X
             | | |                         | | \/
             r o z                         r o  z
```

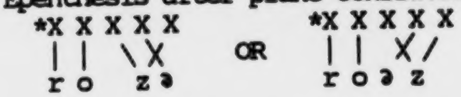
For McCarthy, there can be no intermediate stage (11) between (10)A and (10)B because this would violate the OCP. The form in (11) has undergone plane conflation but each [z] still has its own melody.

(11) Stage intermediate between (10)A and B

```
        *X X X X
         | | | |
         r o z z
```

If (11) were allowed, epenthesis could apply at this stage yielding the correct [rozəz]. Epenthesis cannot take place after the planes are conflated in (10)B because this would result in a violation of the line crossing convention as in (12).

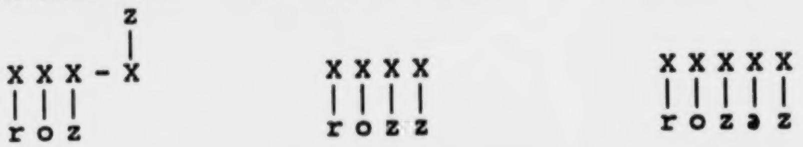
(12) Epenthesis after plane conflation



Yip (1988) argues for a weakened version of the OCP by allowing for the intermediate stage in (11). In fact, she claims that this ill-formed representation is exactly what triggers rules like [ə] epenthesis. For her, then, the underlying representation of the plural morpheme is /z/. The derivation of roses proceeds as in (13).

(13) Derivation of [rozəz] à la Yip

A. Pre conflation B. Post conflation C. Epenthesis



Yip views the OCP as an active constraint whose function is to mark a representation as ill-formed, thereby requiring that it be repaired. Plane conflation, then, does not automatically result in a form which is indistinguishable from one which is monomorphemic; there is an intermediate stage during which each [z] may have its own melody.

In terms of learnability, we may wish to adopt McCarthy's view over Yip's as (segmental) active constraints can be argued to be undesirable. They are simply statements of the conditions under which a particular rule or rules applies. As such, they are a derived property of the phonology and do not simplify the grammatical apparatus in any way; in fact, they add to its complexity in terms of storage.

McCarthy's view of the OCP is completely compatible with the gemination stage in the acquisition of the [əz] allomorph. The child hypothesizes that the OCP operates as a passive constraint. There is no stage during which it is violated and so the merging of the two identical segmental matrices and plane conflation happen simultaneously. To achieve the gemination result, though, we must assume that the child has postulated /z/ rather than /əz/ as the underlying representation.

Evidence for /z/ as underlying is as follows. One, recall that at the point at which the child is invoking the gemination strategy to deal with the [əz] allomorph, s/he is correctly adding [s/z] to non-sibilant obstruent-final stems and [z] to sonorant-final stems. Two, if the underlying representation were /əz/, we would expect the syllabic allomorphs to be acquired first since no rules need apply to derive the surface representations. Three, as the presence of [ə] breaks up two consonants resulting in a simpler syllable structure, we might expect the child to retain the underlying [ə] in some non-sibilant cases to avoid his/her having to produce difficult clusters; for example, we might expect to hear [dagəz] for dogs and [kaetəz] for cats. Further, there is evidence from adult English that the underlying representation is /z/. Recall that if the underlying representation is /əz/, the [ə] must delete everywhere except if an OCP violation were to result. Nonalternating inflections like the comparative, the superlative, and the progressive which are clearly /əC(C)/ underlyingly should then undergo the same syllabic-nonsyllabic alternations exhibited by the plural. However, their vowels never delete as shown in (14) for the superlative.

(14) Superlative inflection
biggest —> [bɪgəst], *[bɪgzd]   ripest —> [raipəst], *[raipst]
thinnest —> [θɪnəst], *[θɪnzd]   nicest —> [naisəst]

This indicates that the underlying representation of the plural must be a single consonant only, /z/. Additional evidence that the plural and superlative have different underlying representations (in terms of their syllabicity) is that children never overgeneralize deletion to the ungrammatical forms in (14), yielding *[bɪgzd] for instance.

The gemination strategy is abandoned by children once the constraint against tauto-syllabic geminates is acquired. In keeping with McCarthy's assumption about the operation of the OCP as a passive constraint, the child opts for deletion. The plural [s/z] is not syllabifiable after sibilant-final roots due to the constraint and is therefore subject to stray consonant erasure. This results in [roz], a form, albeit incorrect, which does not violate English phonotactics.

Ultimately, the child must acquire the adult representation. The deletion stage persists for some time. I suggest that this is because, to maintain the assumption that the OCP operates as a passive constraint, the child may only reach the adult stage if s/he postulates /əz/ as underlying. However, as mentioned earlier, there is evidence against this. The only other alternative is for the child to assume the OCP operates as an active constraint. Thus, as a result of plane conflation, the two segmental matrices are not immediately merged; instead, each still has its own segmental matrix. The OCP operates at this stage to trigger epenthesis.

This analysis requires that the operation of the OCP be parametrically determined. Note that the OCP's status as a universal constraint on representations is unaffected; only its operation, as a passive constraint or as an active constraint, must be determined on a language specific basis. I follow Hyams (1983) in claiming that the child does not require positive evidence to set the unmarked value of a parameter. In the case of the OCP, this results in him/her initially assuming that it operates as a passive constraint, regardless of the language s/he is acquiring. In English, where the OCP operates in the marked way as an active constraint, this correctly predicts overgeneralization, both as gemination and deletion. Of course, positive evidence is needed to reset the parameter to its marked value; this comes in the form of [ə] epenthesis.

Note.

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WH-QUESTIONS AND EXTRACTION FROM TEMPORAL ADJUNCTS: A CASE FOR MOVEMENT

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This paper reports the results of an experiment testing children's knowledge of the constraint that prevents questioning from a position inside a temporal adjunct, i.e. knowledge of the ungrammaticality of questions such as,

1. *Who did Fred kiss Sue before hugging _?

We find that children as young as three years show awareness of the constraint. We interpret these results as evidence that children form questions in English by movement (by an operation linking deep structure to surface structure).

I. Islands and movement

Languages are widely agreed to differ in whether they have movement "in the syntax", linking deep and surface structures. A standard diagnostic of a language with movement in the syntax is obedience to structural constraints. Languages which form questions and other sentence types by dislocating an element from its underlying position tend to obey "island" conditions, limiting the positions from which an element may be moved. The block on movement from within a temporal clause is one such structural condition. Languages such as English, which form questions by dislocating the question word to the front of the sentence obey the constraint exemplified in (1); languages such as Chinese and Japanese, which do not form questions by dislocation of a question word, allow questions (including the equivalent of (1)) that are ungrammatical in English-type languages. (For pertinent discussion, see, for example, Huang 1982). We chose the temporal island to extraction as a focus of our test because it appears to be a very good indicator of language type. That is, unlike some other islands (for example complex NPs), it seems to be relatively immune to exceptions -- languages which form questions by dislocation of elements from their underlying position obey the constraint, those that do not form questions in that way allow questions equivalent to (1). The temporal island constraint is also explicable in terms of more general principles of grammar that putatively govern movement rules (specifically, subjacency), although this is not unproblematic (for recent discussion, see Chomsky 1986; Lightfoot and Weinberg, 1988).

II. The experiment[1]

II.1 Materials, subjects and procedure

Our experiment uses a picture-cued question-response task of the kind used by deVilliers, Roeper and Vainikka (1988). The child listens to "stories" about animals; each story consists of a sequence of four sentences, each accompanied by a picture. While looking at the last picture the child is asked a potentially ambiguous question, designed to probe his knowledge of syntactic conditions on movement.

There are three conditions in the experiment, with three stories for each condition. A sample story from each condition is given in (2A-C).[2]

2. A -- Temporal adjunct island
Story: The fox ran down to the river
First he ate an ice-cream cone
Then he whistled a tune he'd heard on the radio
The fox felt pretty happy.
Question: What did the fox eat before whistling?
Potential answers -- Upstairs: icecream
-- Downstairs: a tune

B -- ask plus complement in the verb phrase
Story: The zebra was feeling happy
He just wanted to hug and kiss everyone
The zebra asked the lion: "Shall we kiss the monkey?"
The zebra was a kind animal
Question: Who did the zebra ask to kiss?
Potential answers -- Upstairs: the lion
-- Downstairs: the monkey

C -- ask plus temporal adjunct island
Story: The elephant liked to work
She asked the tiger: "Shall I help the horse carry those boxes?"
The tiger said "Yes!", so the elephant helped the horse.
The elephant was tired at the end of it all.
Question: Who did the elephant ask before helping?
Potential Answers -- Upstairs: the tiger
-- Downstairs: the horse

For all three conditions (A-C), the verbs in both the main and subordinate clause are optionally transitive. As a result each question has two logically possible answers - an "upstairs" answer, where the question word is taken to refer to the object position of the main clause, and a "downstairs" answer, where the question word is taken to refer to the object position of the embedded clause. In conditions A and C, where the embedded clause is a temporal adjunct, only the upstairs option is permitted in the adult grammar of English.[3] In condition B, where the embedded clause is a complement to the main clause verb phrase, the question is genuinely ambiguous in the adult grammar, and either upstairs or downstairs answers are permitted.[4]

Our test of knowledge of the temporal island condition involves evaluating children's performance across the three conditions. Under the temporal island condition, we expect only upstairs answers to conditions A and C. Condition B gives us a control that preference for upstairs answers to conditions A and C is not simply a reflex of a preference for making the question word refer to a position inside a main as opposed to subordinate clause. In combination, conditions A, B and C give us some measure of the generality of the constraint--i.e whether or not apparent obedience to the constraint can be explained in terms of lexical preferences (preferences for particular verbs being construed as transitive). The adjunct island conditions A and C vary the type of predicates involved (two action verbs such as eat for A and one action verb and the verb ask for C). Since the same predicate types were used in both B and C, any difference in amount of downstairs answers for B vs. C is unlikely to be due to lexical preferences concerning whether particular verbs are transitive.[5] As an additional control against lexically-dependent results, half the subjects received materials with temporal adjuncts introduced by the preposition before and half received materials with the preposition after; thus for half the subjects the probe questions for the examples of conditions A and C were as given in (2) and for the other half the questions were, respectively, "What did the fox whistle after eating?" and "Who did the elephant help after asking?").

Thirty 3-5 year old children were tested (10 threes, 10 fours and 10 fives). The pictures for each story were bound in a 8 1/2 x 11 1/2 inch folder; the experimenter (JS) turned the pages of the folder for the child as she read the story to the child. The folders were shuffled to produce an individual order of presentation for each child, with the constraint that no runs of more than two stories in any condition were permitted. If a child did not respond on first presentation of the story, the folder was returned to at the end of the experiment for a second (and, if necessary, third) trial. Sessions were tape-recorded.

II.2 Results

Table 1 gives the results of the experiment in terms of the percentage upstairs, downstairs and "other" responses for the three conditions, by age group. We accepted as upstairs or downstairs answers responses that were not completely faithful to the content of the story, but which were plausibly an answer to one but not the other of the two predicates in the question (for example, the answer "a song" would be scored as a downstairs answer to the question for the story in 2A). In all, there were 26 non-exact answers of this type (9.5% of the total data, including failures to respond) that we accepted as upstairs or downstairs answers.

The percentage figures for conditions A and C (Table 1) show that by age five years children are very clear-cut in their obedience to the temporal island constraint; moreover, the results for condition B indicate that this is not simply the result of a preference for extraction from the main clause. The results for the three and four year olds are less clear-cut, but nonetheless show the same pattern as that for five year olds. As the figures in Table 1 show, the main development over age was for Other responses to be replaced by upstairs responses, for all three conditions. There was a significant main effect of age for upstairs answers (F(2,27)=9.65, $p < .001$) but not for downstairs answers (F(2,27)=1.72, $p < .20$). Whether the child received materials with the preposition before or after had no significant effect of proportion of correct (upstairs) responses for either condition A or C (there was a very small trend in favor of more correct responses with before).

TABLE 1
Percentage Responses
by Age

	Condition A			Condition B			Condition C		
	U	D	OT	U	D	OT	U	D	OT
3 yrs	50	13	36	37	43	20	47	20	33
4 yrs	60	7	33	23	53	23	70	7	23
5 yrs	90	3	7	53	40	7	100	0	0

U = Upstairs; D = Downstairs; OT = Other

Table 2 summarizes the distribution of children in terms of individual response patterns over the three conditions. We took as criterion for knowledge of the constraint a response pattern with a least one downstairs response for condition B and both a greater number of upstairs responses for condition A than for condition B and a greater number of upstairs responses for condition C than for condition B. Of the 20 possible patterns of responses that were "pass" patterns by our criterion, 13 were exemplified among the 19 children who met criterion.

Table 2
Number of Children with
"Pass" Response Patterns

3 years	4
4 years	7
5 years	8

We wish to argue that our results indicate that by age three years children obey the adjunct island condition. By the logic that takes obedience to the constraint as a diagnostic of movement in the syntax, children at this age are forming questions by a movement operation of the same type as that in the adult grammar of English.[6]

III. Discussion

The development of movement rules has recently become a hot topic in language acquisition studies. A series of questions and proposals have come out of the literature of the last three or four years, including:

1. At a young age (say, before four years) children learning English-type languages may lack movement (Roeper 1986; deVilliers, Roeper and Vainikka 1988).

2. Within languages with movement as an operation between deep structure and surface structure, movement may develop at a different pace in different languages and different constructions (Weissenborn 1988; Labelle 1988; Goodluck and Behne 1988; Wexler 1988, 1989).

3. Constraints on movement may be violated (Wilson and Peters 1988).

We will not attempt to discuss all of this literature, but we need to address a basic question. We have argued that children as young as three obey the temporal adjunct island constraint and from that we have concluded that children at that age have established movement between deep structure and surface structure as an operation in their grammars. How can this be reconciled with the claims above, particularly claim (1) (that children may lack movement) and claim (3) (constraints may be violated)?

Roeper's (1986) claim that children may lack movement was based on the fact that some children aged 5-7 interpreted who and the pronoun he as coreferential in an experiment that tested strong cross-over sentences such as,

3. *Who$_i$ does he$_i$ think has a hat?

The ungrammaticality of such sentences (on the coreferential reading) is generally taken to result from a violation of principle C of Chomsky's binding theory (see Lasnik and Uriagereka, 1988 for summary and discussion); that is, from the ungrammaticality of binding the trace of who with the NP he. If children do not have movement, and hence do not have traces, sentences such as (3), might be permitted without any violation of grammatical principles; Roeper proposes that an unpronounced pronominal element (pro) may occupy the position of trace in the child's grammar.

We do not have any neat solution to Roeper's data, but we believe the weight of the evidence supports movement (and traces/bound variables). In addition to our results, in one experiment Roeper found that children who gave answers in violation of the cross-over constraint also gave multiple answers to questions such as (3), an interpretation that (as Roeper notes) will surely require a variable in the linguistic representation. Possibly the errors made by the children in Roeper's experiments were some kind of performance error. (C. McKee informs us of pilot data from an experiment she is conducting with D. McDaniel that suggests children's errors with strong cross-over are performance-based).[7,8]

Wilson and Peters 1988 report the case of a three year old child who went though a period of moving a noun to the front of the sentence, stranding in some cases determiner material (4a), and in others leaving part of a compound word behind (4b),

4.a What did I get lost at the, Dad?
(cf. I got lost at the store)
b What are you cooking pan?
(cf. You are cooking pancakes)

Taking island constraints as diagnostic of movement, these examples are not in fact evidence against movement, but evidence of an incorrrect conception of what gets moved. As Wilson and Peters observe, errors such as those in (4) will result if the child is not aware that maximal projections, rather than heads, are what move. This does not, however, really lessen the oddity of the errors in (4). It is tempting to draw comparison with various types of incorporation processes in many languages, whereby nouns may be incorporated into verbs, stranding determiners, etc. (see Baker 1988 and references therein for many examples). However, the analogy is no more than an analogy. Incorporation is a lowering/morphological operation. The movement in (4) involves raising, presumably into Comp; no English-type languages we know of permit such questions and possibly such questions are ungrammatical in any language.[9]

IV. Summary and conclusion

By the test of obedience to an island constraint, we have argued that children learning English have movement in the syntax as early as three years. Thus children aged three have formed a grammar that is similar in a fundamental way to the adult grammar they are exposed to. This does not mean that they have nothing left to learn. Data such as Wilson and Peters' presents an interesting challenge for a common assumption in language acquisition studies -- that is, that the child's developing grammar should always fall within the range of language systems exemplified in adult grammars. Children should not have "rogue grammars", to borrow a term from Finer (1989). Whether such a constraint on child grammars can be sustained in its strongest form in the face of data such as Wilson and Peters' seems to us an interesting question to pursue.

Acknowledgements

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Footnotes

1. Ours is not the first attempt to establish children's sensitivity to islands, particularly subjacency. Several studies have looked at children's sensitivity to constraints on extraction from NPs, with results that are largely ambiguous or indeterminate (see Otsu 1981; Crain and Fodor 1984; Goodluck, to appear). Perhaps this reflects the fact that the constraints tested in those studies are subject to a degree of cross-linguistic and even individual-speaker variation even within languages with movement. Such variation suggests that the superficial form of the constructions involved may be amenable to more than one analysis, and thus present a special challenge for the learner who has to figure out which is the correct analysis for the language/dialect s/he is learning.

2. A complete set of materials is available on request.

3. The temporal complement structure in our materials is ambiguous between a verbal and nominal gerund structure. This ambiguity does not

affect the basic point we make concerning islands and movement, although the details of structure that the children are reacting to remains to a degree indeterminate in a way that may have substantial consequences for understanding other areas of development (see Wexler 1989).

4. In fact, condition B contained two stories with the matrix verb ask and one with the matrix verb want. Thus upstairs answers for one token in the condition involved extraction from subordinate subject position, rather than matrix object position. We included one token with want since we were initially not confident that ask would produce enough lower object extractions to provide the control we needed (see below); deVilliers, Roeper and Vainikka (1988) report 70% of responses to questions exactly of the form in 2B involved taking the question word as main clause object. We obtain a somewhat higher proportion of lower-object interpretations with condition B (see below). Each token contributed to the total lower object extractions, with one token with ask contributing somewhat less than the other token with ask or that with want.

5. We were particularly concerned that in conditions A/C children might jump at the main clause object position as a location for the wh-word, without listening to the whole question (i.e. they would plug the wh-word in as object of the main clause as soon as the matrix verb had been input). Literature on sentence processing from Fodor (1978) onwards argues that this is a real possibility and it may be the source of some correct answers for conditions A/C, although it plainly cannot account for any difference we find between B and C. One response was categorised as "Other" because the child clearly jumped the gun and responded before the experimenter had finished the question.

6. We leave open here whether those errors that do occur for Conditions A and C can be dismissed as performance errors; an error on these conditions is always compatible with a recency effect (responding to the last-mentioned predicate in the test question). We included a follow-up question to condition C, to test whether errors correlated with generally poorer recall of the story. Due to administrative error, we do not have complete data for the follow-up and can draw no firm conclusions from it.

7. In a longer version of this paper (ms. April 1989) we sketch a combined competence/performance account of such errors.

8. DeVilliers, Roeper and Vainikka (1988) discuss other data in the context of a no-movement account of early grammars. For reasons of space we will not discuss their arguments here, although we believe their data is accountable for under a grammar with movement. Roeper and deVilliers (1989) present some data on extraction from small clause vs. nominalization structures for 4-6 year olds that they suggest is evidence for movement.

9. A less radical analogy might be between movement of N and V raising, as in some analyses of the verbal system of French and other languages (for example, Pollock, 1987).

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THE SONORITY CYCLE IN THE ACQUISITION OF PHONOLOGY

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0. Introduction

It is well-known that children use syllable structure as a unit of organization from the earliest stages of language development. In this paper we show that the development of syllables over time follows a constraint which has been observed to hold on syllable structure cross-linguistically. We suggest that this can more generally be viewed as the result of a constraint on the mental representation of language, i.e. a principle of Universal Grammar, as proposed by Chomsky (e.g. 1986). In section 1., we introduce a recently proposed Constraint on Syllable Structure, namely the Sonority Cycle (Clements to appear, henceforth SC) and illustrate how it accounts for syllabic structure across languages. In section 2. we show how the SC makes several predictions for child language acquisition, when viewed as a principle of Universal Grammar. In section 3. we present some data from the literature as well as from an ongoing longitudinal study to suggest that the predictions for acquisition are borne out, thus providing preliminary support for the postulation of the Sonority Cycle as a constraint on the mental representation of language.

1. The Theory: The Sonority Cycle

In phonological theory, sonority, defined as a scalar feature distinguishing various classes of segments, was conceived primarily to explain preferred patterns of syllable structure that have been observed cross-linguistically. The Sonority Sequencing Principle, originally found in the work of Sievers (1881) and Jespersen (1904), states that within the syllable, segments should increase in sonority as one proceeds from the margins to the peak. The constraint we consider in this paper is a reformulation of the Sonority Sequencing Principle, namely the Sonority Cycle proposed recently in Clements 1988. It states that the preferred syllable type rises sharply in sonority at the beginning, but drops gradually toward the end giving the pattern illustrated in 1.

1. The Sonority Cycle (Clements 1988)
   "...the sonority profile of the preferred syllable type rises sharply at the beginning and drops slowly toward the end."

In this section we give a brief overview of the definitions and principles underlying the Sonority Cycle. Clements proposes that the sonority rank for each class of segments be derived from a set of binary features and measured in terms of the sum of the [+] specifications for each feature. He thus arrives at the classification in 2. whereby obstruents rank lower in sonority than nasals, nasals rank lower then liquids, liquids rank lower than glides and glides rank lower than vowels.

2. Major Class Features in the Definition of Sonority (Clements 1988)

O <	N <	L <	G <	V	
-	-	-	-	+	syllabic
-	-	-	+	+	vocoid
-	-	+	+	+	approximant
-	+	+	+	+	sonorant
0	1	2	3	4	rank (relative sonority)

O = obstruents, N = nasals, L = liquids, G = Glides, V = Vowels

1.1. The demisyllable

In Clements' proposal, the basic unit for which sonority is measured is not the syllable itself, but the demi-syllable, i.e. initial and final demisyllables as defined in 3. below. Here, the syllable is divided into two overlapping parts, sharing the nucleus.

3. " A demisyllable is a maximal sequence of tautosyllabic segments of the form $C_m ... C_n V$ or $VC_m ... C_n$, where $n > m > 0$."

Thus, in the closed syllable *mat* , the initial demisyllable consists of the sequence *ma* while the final demisyllable is formed by the sequence *at*. Using the demisyllable as opposed to the syllable allows for a differentiation in the definition of optimality for onsets on the one hand and codas on the other, a phenomenon that has been attested cross-linguistically (cf. Greenberg 1978). Each demisyllable type is assigned a value D, measured in terms of the dispersion in sonority within it as seen in 4.

4. D values for Initial and Final Demisyllable Types

ID	FD		D
OV	VO	=	0.6
NV	VN	=	.11
LV	VL	=	.25
GV	VG	=	1.00

The difference in optimality between initial and final demisyllables is formalized in the Dispersion Principle which states that the preferred initial demisyllable minimizes D, while the preferred final demisyllable maximizes D. Demisyllable types can now be ranked for optimality or conversely, for complexity, in terms of their sonority profiles, resulting in the ranking illustrated in 5.

5. Complexity Rankings for Initial and Final Demisyllable Types

ID	C	FD	C
OV	1	VG	1
NV	2	VL	2
LV	3	VN	3
GV	4	VO	4

ID = Initial Demisyllable
FD = Final Demisyllable
C = Complexity

Here, the numbers indicate relative complexity, with the lowest number being the least complex (hence optimal) demisyllable type. The complexity measure is extended to one-member demisyllables (i.e. consisting of one segment only): an initial demisyllable consisting of a vowel (e.g. in the syllable *am*, the initial demisyllable is the vowel *a*) is assigned the complexity measure 5; a final demisyllable consisting of a vowel (e.g. in the syllable *ma* the final demisyllable is *a*) is assigned 0.

1.2. Cross-linguistic Preferences

Several cross-linguistically observed phenomena can now be accounted for directly by the Sonority Cycle. In this paper we will focus on three:

i. The CV syllable is the least complex, hence "unmarked" syllable type.
If the complexity measure of a syllable is defined as the sum of the complexity measures of its initial demisyllable and its final demisyllable, it becomes possible to rank syllable types by the Sonority Cycle. In particular, the SC predicts that any syllable with an onset and without a coda, for example *pa* , has a lower complexity measure than any syllable without an onset and with a coda, for example *ap*. This can be seen by comparing the complexity scores in 5. above, for the most complex open syllable type to that for the least complex closed syllable type (see 6.)

6. The complexity measure for any given syllable is the sum of the complexity measures of its id and its fd.

The most complex CV is less complex than the least complex VC :
most complex CV : GV = GV (4) + V (1) = 5
least complex VC : VG = V (5) + VG (1) = 6

Thus, the Sonority Cycle predicts the CV syllable to be the least complex syllable type.

ii. The Sonority Cycle accounts directly for what has been termed the Maximal Onset Principle. This principle requires that the sequence VCV be syllabified as V.CV, rather than VC.V This can again be seen by a comparison of rankings for initial demisyllables and final demisyllables in 5.

iii. The Sonority Cycle accounts for the Syllable Contact Law (Hooper 1972, Murray and Venneman 1983), which states that the preferred contact between two consecutive syllables is one in which the end of the first syllable is higher in sonority than the beginning of the second, thus showing a decline in sonority transsyllabically.

2. The SC as a Principle of Universal Grammar

As mentioned above, sonority was conceived primarily to explain preferred syllable types cross-linguistically. What is the relevance of the Sonority Cycle to acquisition? Clements proposes the Sonority Cycle as a universal (rather than a language-specific) principle, and imputes it to the implicit (rather than "conscious") knowledge of speakers. It can thus be conceived of as a principle of Universal Grammar in the sense of Chomsky (e.g. 1986). UG principles have in recent linguistic theory been defined as constraints on the mental representation of linguistic units. Extending this definition to the Sonority Cycle, it could be viewed as an initial constraint on possible syllable structure. This constraint would then subsequently be relaxed as the child is presented with exmaples violating it, that is, by the presentation of positive evidence that the language allows syllable types which diverge from the optimal type as specified by the Sonority Cycle. Under this view, the SC makes several verifiable empirical prediction for language acquisition. Extending the generalizations stated in i - iii above to acquisition it is predicted that phonological development should be guided by the following principles:

(a) CV syllables should appear before VC syllables
(b) a VCV sequence will be syllabified as V. CV rather than VC. V
(c) the preferred contact between two consecutive syllables is one where the end of the first syllable is higher in sonority than the beginning of the second.

3. The Data

In this section we will present some data supporting the above predictions.

3.1. Primacy of the CV syllable

The first prediction can be translated to state that the CV syllable is the unmarked one, i.e. the one the child will start with, since it represents the optimal syllable type as defined by the Sonority Cycle. The literature on child phonology widely attests a marked preference for CV syllables which extends from the babbling period through early meaningful speech, to later stages in acquisition when language-specific rule learning is well in progress (4-5 yrs). This preference has been noted in cross-sectional as well as longitudinal studies, in experimental studies observing larger groups of children (Winitz and Irwin 1959, Stoel-Gammon 1985, Ingram 1974) and in the classical diary studies of single children (cf. Leopold 1947, Velten 1943, Smith 1982 etc.). Furthermore, it has been observed in children of many different language backgrounds (cf. Locke 1983, Jakobson 1968), and, somewhat surprisingly, in the babbling of deaf children (cf. Syken 1940).

3.1.1. CV in the Babbling Stage

It is of some interest that the late babbling period, i.e. the period of vocalization in the month (or so) prior to the onset of meaningful speech should be marked by CV syllables. This has often been taken as evidence that Jakobson's fundamental distinction between babbling and early speech was basically incorrect (cf. de Villiers and de Villiers 1974, Menn 1982, etc.) The babbling period is described by Jakobson as containing "an astonishing quantity and diversity of sound productions." He cites Grégoire's (1937) observation that at the height of the babbling period the child "is capable of producing all conceivable sound". The onset of meaningful speech, by contrast, is characterized according to Jakobson by a drastic reduction in the sounds produced.[1] He attributes this to the child's emerging system of phonemic oppositions.

The claim of unconstrained babbling has since been challenged by many researchers (cf. Oller et al. 1976), who found that while infants do produce segments which are absent from the language of their particular linguistic community, such segments occur only occasionally. Preference seems instead to be given to those segments which also predominate early meaningful speech, i.e. stops and nasals. This has led most researchers to postulate a continuous transition from babbling to early speech rather than the abrupt qualitative change from chaotic sound production to structured vocalization hypothesized by Jakobson. This continuity seems to hold for syllable structure as well: For example,

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[1] It should be mentioned that Jakobson seemed to restrict his observations to the production of segments rather than to syllable type.

Locke (1983) writes that the preference for CV syllables is "one of the more compelling patterns" in the babbling of infants as well as in early speech. Stoel-Gammon and Cooper (1985) report that in late babbling, CV syllables occur much more frequently than single V's or CVC syllables. This fact has also been pointed out by Cruttenden (1970).

3.1.2. CV Syllables in Early Meaningful Speech

The evidence for the predominance of CV syllables in early child language is equally well-attested. Surveys of phonological processes in language acquisition (like Macken and Ferguson 1982, de Villiers and de Villiers 1974), etc. invariably point out this fact. To cite an example, Locke (1983) reports that in the 50 word vocalization of a Czech child, 92.8% of the items were CV syllables.

The child's preference for CV syllables is attested by two phenomena: predominance of CV in spontaneous early utterances, and the structure changing processes which conform (adult) non-CV forms to CV patterns. The most commonly-cited processes in the literature in this regard are cluster reduction, final consonant deletion and reduplication, all characteristic of early child language cross-linguistically. Some examples from the literature are given below.

7. (a) Final consonant deletion:

English:
bird --> bo (Ingram 1974)
dog --> da (de Villiers and de Villiers 1974)
goose --> gu (Branigan 1976)
hi --> ha (Branigan 1976)
bath --> ba (Locke 1983)

French:
place --> fa (Lewis 1936)
Slovenian:
bombon --> bo (Kolaric 1959)

(b) Cluster-reduction by V-epenthesis:

English:
e.g. blue --> belu (Locke 1983)

(c) Cluster reduction by C deletion:

French:
pied /pje/ --> pe (Lewis 1936)

English:
tree --> di (Smith 1982)
taxi --> gegi (Smith 1982)

Slovenian:
mleko --> meko (Locke 1983)

(d) Reduplication of V in CVC forms:

English (Ross 1937):
back --> baga
beach --> bihi
dog --> dogo

Each of these processes changes some adult sequence into a CV pattern. Under the hypothesis we are considering, the preference for CV syllables would be the result of an initial constraint on the mental representation of the syllable as defined by the Sonority Cycle. Support for our hypothesis would be found if it could be shown that this preference is not somehow due to input, or to a constraint on articulation. While obviously such evidence is hard to find, there are some studies which suggest that our hypothesis is correct. Thus, in an early study of deaf children, Syken (1940) determined that CV syllables predominate the babbling of deaf 3-4 year-old children. This would argue against the hypothesis that CV syllables are preferred due to input (i.e. their predominance in the speech of caretakers). Some support also comes from experiments on the perception of speech categories by young infants (2-6 months) which suggest that there is sensitivity to CV syllables even at that early a stage (cf. Eimas 1984, Kuhl 1980, Miller and Eimas 1980). While this is only suggestive, such studies indicate that sensitivity to the CV syllable is to a certain degree independent of articulatory considerations, and would thus be consistent with the hypothesis that proclivity to certain syllable types is the result of a constraint on mental representation.

3.1.3. Beyond CV Syllables

Another fact which coheres with the prediction that the CV template constrains phonemic acquisition is the imbalance in the inventory of consonants in initial and final position, even after children produce CVC syllables freely. This has been noted by Stoel-Gammon 1985, Ingram 1981, Shibamoto and Olmsted 1974, Winitz and Irwin 1959, Branigan 1976). A typical example from the acquisition of English is the following: During a stage where a child has voiced and voiceless stops, several nasals as well as glides in initial position, s/he will typically only have voiceless stops and perhaps one nasal in final position. Stoel-Gammon (1985) statistically calculated consonant frequency in the two syllable positions and reports that for labials and alveolars (i.e. [+anterior]), the difference in use in initial versus final position is significant at $p < .002$. Similar data have been reported for the acquisition of Puerto-Rican Spanish. Anderson and Smith (1987) measured the occurrence of consonants in relative syllable positions in the speech of 2-year-olds, and found that 56% were produced in "syllable-releasing" position (i.e. initial demisyllable, e.g. karloh), whereas only 14% appeared in "syllable-arresting" position (i.e. final demisyllable, e.g. aβril), with 30% in what they termed "ambisyllabic" position. The example they give for this position is the /l/ in bola, and might thus in fact have been syllable-initial as well. These results may have been in part caused by the fact that Spanish has predominantly open syllables. However, they report that the children also omitted target consonants in final demisyllables more frequently than target consonants in initial demisyllables. Furthermore, while stops, fricatives, and nasals appeared freely in initial demisyllables, the majority of consonants produced in final demisyllables (52%) consisted of /h/ and /ʔ/. They also report a lower rate of accuracy in the production of consonants in fd's than in id's. Overall, then, the Spanish data are consistent with the English data, attesting to a higher occurrence of consonants in initial demisyllable position and greater difficulty with consonants in final position. This phenomenon can be explained under the view that CV but not VC is ranked optimal by the Sonority Cycle.

3.2. The Maximal Onset Principle

We will now turn to some data supporting the Sonority Cycle as manifested by the Maximal Onset Principle. The data are from Stemberger (1988) who noted the following processes in the speech of his child Gwendolyn.

3.2.1. Word-final resyllabification:

G went through a stage where V-initial utterances were obligatorily preceded by an inserted glottal stop. When this became optional, there was a tendency for final consonants to be resyllabified with the following word if it began with a V.

8. ...find us --> [fai.nʌs]
...look at --> [je.tat]
...arm is [au.mi:]

3.2.2. H-fusion:

From the age of 2;6.8 to 2;9.19 G resyllabified final voiceless stops with the following syllable if it began with /h/, e.g.

9. ... about him --> [ba.tʰim]
...right here --> [wai.tʰi]
...want hold --> [wa. tʰa:..]

3.2.3. Liaison:

G normally deleted word-final /d,z, nd, nz/. However, when the following word began in a vowel, she would pronounce them, resyllabified to id position.

10. ..head over --> [ha:. dou...]
...untied it --> [?ʌn. tʰai. dit]
...stand up --> [tʰi:. nʌp]

In all the above, the strategy is to 'repair' initial demisyllables of the last optimal shape, i.e. GV or V (rank 4 and 5) by maximizing the onset with the addition of an obstruent or nasal, resulting in id's of rank 1 and 2. If this strategy turns out to be a common one in child speech, this would provide strong evidence for a constraint on the shape of id's, as specified by the Sonority Cycle.

3.3. The Syllable Contact Law.

In this section we present some data from Jenny, a child who participated in one of our ongoing longitudinal studies. Jenny was chosen because she did not have consonant clusters productively, and we were interested to find out if their ememrgence in her speech would in any way follow the predictions of the Sonority Cycle. Here we report only a small part of our findings, bearing evidence for what is predicted by the Sonority Cycle for transsyllabic consonant sequences.

When we started the study, Jenny had no initial clusters, reduced certain medial clusters and had consonant + /s/ clusters in word-final position. Of interest to us are her medial clusters: Jenny reduced all her VO.OV sequences to V.OV. Some examples are shown below.

11 a. Jenny, age 3.2, Medial Clusters:

VO.OV --> V.OV
toothpaste --> [tu.peⁱt]
basket --> [bæ.tət]
footprints --> [fʊ.pɪns]
footsteps --> [fʊ.tɛps]
have to --> [hæ.tu]

11 b. VN.OV
blanket --> [bæn.tət]
envelope --> [ɛŋ.və.lot]
rainbow --> [reⁱm.bo]
dancing shoes --> [dæn.sʌ ʃuz]
monster --> [mʌn.tə]

Obstruent deletion occurred both inside the word as well as across words, as can be seen from the last example in 11a. At the same time, Jenny allowed VN.OV sequences freely, as seen in 11 b. Note that the consonants which were deleted from the VO.OV sequences were otherwise present in her speech, thus barring the possibility that an overall production constraint may have been at work. For example, /k/, produced as a retroflex t (velar fronting) occurred in words like can, come, make, package, etc. /t/ in words like toothpaste, tea, cat, etc. /v/ in envelope. The fact that she allowed VN.OV sequences furthermore shows that it was not a simple constraint against two consonant clusters. Rather, Jenny seemed to restrict her transyllabic clusters to the more optimal type, as defined by the Sonority Cycle, i.e. declining in sonority.

4. Summary.

The data presented in this paper, taken from several studies on phonological development suggests that child language acquisition is constrained by the same principles which have been found to hold on syllable structure cross-linguistically. In particular, we have focussed on the predominance of CV syllables in babbling and early meaningful speech, the imbalance of inventories of syllable-initial consonants as opposed to syllable-final consonants, and several processes in child speech which have the effect of repairing certain syllable types which are defined as non-optimal by the Sonority Cycle. We have suggested that the hypothesis of the Sonority Cycle as a constraint on the mental representation of syllable structure can provide a unified explanation of these data.

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AN ACOUSTIC ANALYSIS OF YOUNG CHILDREN'S PRODUCTIONS OF WORD STRESS

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Prosodic phenomena such as stress have tended to receive little attention in the literature on child phonology. Word stress, also sometimes called accent or stress-accent, is defined as giving prominence to one or more syllables of a multi-syllabic word. In adult English, stressed syllables can be identified by several acoustic characteristics:

1. Intensity (stressed syllables may be louder).
2. Fundamental frequency (stressed syllables may be higher or lower in pitch).
3. Duration (stressed syllables may be louder).
4. Frequency spectrum (vowel quality in stressed syllables may be more distinct).

In adult English, the actual use of these characteristics varies greatly. Any combination of these factors may be used to mark the stressed syllable (or syllables) in a word.

Not much is known about how or when children make use of these acoustic features to mark stress in words. Allen and Hawkins (1980) have suggested that children have particular difficulty in the reduction of unstressed syllables, that is, in decreasing the length or reducing the vowel quality of unstressed syllables. They observed that young children instead tend to either delete unstressed syllables altogether or to produce them with stress.

In a study of five children between two and four years of age, Allen and Hawkins (1980) found that correct reduction of unstressed syllables ranged from only 35 to 65%. They also noted that the tendency to completely delete unstressed syllables occurred most often in word-initial position (e.g., [weI] for away).

In another study, Allen and Hawkins (1980) looked at children's use of fundamental frequency as well as duration. In words produced by three children approximately three years of age, stressed syllables were both longer in duration and higher in pitch.

In both of these studies, real words were the focus of analysis. In later studies (Allen & Hawkins, 1980), nonsense words were constructed to allow for control over stress placement. Words were identical in segmental content, but differed in stress placement (e.g., ['taki] and [ta'ki]). Data from English speaking children from approximately three to seven years of age indicted that the children had little difficulty perceiving the difference between these pairs of words. However, some of the children had difficulty producing the words with second syllable stress (e.g., [ta'ki]). On the basis of these studies, Allen and Hawkins proposed that children are operating with a trochaic constraint, and are biased towards words with falling stress patterns.

Informal observations of young children's early attempts at two-syllable words have suggested that such words are often produced with two equally stressed syllables or with stress on the wrong syllable (e.g., Leopold, 1947; Menn, 1976). Two descriptive studies of children approximately two years of age have also reported this use of level stress or misplaced stress. Klein (1984) looked at the multisyllabic productions of a single English-speaking two-year-old, and found a great deal of variability. Some words were produced with correct stress, some with misplaced stress, and others with level stress. Interestingly, newer words and imitations of novel words showed the greatest amount of variability. Words that were more established in the child's vocabulary were produced with more consistent stress assignment. Hochberg (1988) looked at the production of stress in four Spanish-speaking children. Spanish has a more even distribution of words with final and penultimate stress than English. At the beginning of the study, when the children were 19 to 22 months of age, accuracy of stress placement was essentially at chance level. The children were no better or worse in accuracy on words with final versus penultimate stress. Over time, three of the children improved in their accuracy of stress production. On the basis of these data, Hochberg argued that children do not show a trochaic bias in their productions, but rather have a "neutral start" and are unbiased towards any particular stress type.

Both Klein's and Hochberg's studies used perceptual transcriptions of stress. The analysis of data based on perceptual transcriptions is of some concern. Interjudge reliability of stress transcription with young children is typically poor. Brammer (1988) found average interjudge reliability for stress transcription increased with subject age, averaging 69% for two-year-olds, 74% for three-year-olds, and 83% for four-year-olds. One possible explanation for the poorer reliability with the younger children is that they may not be consistent in their use of acoustic features for marking stress, and therefore may be providing the listeners with inconsistent or unreliable cues.

The purpose of the present study was to investigate children's use of three acoustic parameters in the production of two-syllable nonsense words. The specific questions addressed were:

1) Which acoustic parameters (intensity, fundamental frequency, duration) are altered?

2) Is there a difference in the use of these acoustic parameters across different age groups?

3) Is there a difference in the use of these parameters when the stressed syllable is in the first position versus the second position of the word?

Method

Subjects were six children each at two, three, and four years of age. All were screened for age-appropriate language skills and normal hearing sensitivity.

Eight novel CVCV words were created, controlling for segmental content and stress placement. All were of the shape CVCV. Two pairs of syllables, [bə] - [fi] and [bo] - [da], were used. Words were created by altering the placement of these syllables within the word, and altering the placement of stress. The resulting experimental words are shown in Table 1. Referents for each word were unfamiliar objects to the children (e.g., a plastic grip for a bicycle handlebar).

The experiment was conducted in a quiet room while the subject and experimenter played with both familiar toys and the unfamiliar objects. The experimental words were elicited through an imitation procedure. The eight words were presented in a random order, with the restriction that words with identical segmental structure (e.g., ['boda] and [bo'da]) were not presented consecutively. Each object was drawn from a bag by the examiner accompanied with a phrase, such as "Here's a ____." With the younger children, spontaneous imitation of the experimental word often occurred. With the older subjects, imitations often needed to be prompted with the question, "What is it?" or "What's its name?" Repeated presentations of the objects were made in an attempt to elicit at least three token productions of each word. However, it was not always possible to obtain three tokens for all subjects, due to inattention to the task over time. As a result, a different number of productions were obtained for each subject. Table 2 shows the number of productions elicited for each age group for both first syllable stressed and second syllable stressed words. There were slightly fewer second syllable stressed words produced overall, due in part to the tendency of several two-year-old subjects to delete initial unstressed syllables.

All experimental sessions were audiorecorded for later acoustic analysis. Productions that occurred more than 15 seconds after the adult's model were not included in the analyses. Measures of peak fundamental frequency and peak intensity for each syllable were made using a Kay Elemetrics Model 6095 Visipitch. Measures of the absolute duration of each vowel were made from wide band spectrograms (600 Hz analyzing filter) using a Kay Elemetrics Digital Sona Graph Model 7800.

Table 1. Experimental words.

'CVCV	CV'CV
'bəfi	bə'fi
'fibə	fi'bə
'boda	bo'da
'dabo	da'bo

Table 2. Number of words elicited.

Age	'CVCV	CV'CV	Total
2	67	54	121
3	70	65	136
4	74	81	155
Total	211	201	412

Results

The acoustic data were analyzed by three-factor mixed design analyses of variance (ANOVA) with repeated measures on two factors. A separate analysis was conducted for each of the three acoustic measures. Age (two, three, or four years) served as the between subjects variable. Stress level (stressed or unstressed) and syllable position (first or second) served as within subject variables.

Intensity. Each subject's mean peak intensity for stressed and unstressed syllables in first and second position is shown in Table 3. Results of the ANOVA for intensity revealed that the main effect of stress level was statistically significant, $F(1,15) = 38.96$, $p < .001$, indicating that the stressed syllable was more intense than the unstressed syllable. The main effects of age and syllable position were not significant. However, a two-way interaction between age and stress level was significant, $F(2,15) = 7.86$, $p < .005$. This interaction is displayed graphically in Figure 1. The graph indicates that the stressed syllable was more intense than the unstressed syllable for the three- and four-year-olds, but not for the two-year-olds. No difference was apparent between the three- and four-year-olds.

Fundamental Frequency. Table 4 shows each subject's mean peak fundamental frequency for the stressed and unstressed syllables in first and second position. The results of the ANOVA found the main effect of stress level to be statistically significant, $F(1,15) = 11.28$, $p < .005$, confirming that the peak frequency of the stressed syllable was higher than that of the unstressed syllable. The main effects of age and syllable position were not significant. No interaction effects reached the significance level of .05. However, the two-way interaction between age and stress level approached significance, $F(2,15) = 3.54$, $p = .055$, which suggests that the peak frequency of the stressed syllable was not consistently higher for all age groups. This interaction is shown in Figure 2, and suggests that the effect of stress is present for the three- and four-year-olds, but not for the two-year-olds. No difference was observed between the three- and four-year-olds.

Duration. The mean duration of the vowels in stressed and unstressed syllables in first and second position for each subject is shown in Table 5. The results of the duration ANOVA found the main effect of stress level to be statistically significant, $F(1,15) = 127.02$, $p < .001$, indicating that stressed syllables were longer on the average than unstressed syllables. The main effect of syllable position was also significant, $F(1,15) = 44.35$, $p < .001$. That is, the duration of the second syllable was significantly longer than the duration of the first syllable. The main effect of age was not significant.

As with the other measures, there was a significant interaction between age and stress level, $F(2,15) = 8.53$, $p < .005$. This interaction is displayed in Figure 3, which indicates that the effect of stress level is strongest for the three- and four-year-olds, although it is also present to a degree for the two-year-olds. The interaction between stress level and syllable position was also significant, $F(1,15) = 52.06$, $p < .001$. This interaction is shown in Figure 4, and indicates that the stressed syllable is longer if in the second position. Finally, the three-way interaction between age, stress level, and syllable position was significant, $F(2,15) = 14.75$, $p < .001$. Figure 5

Table 3. Mean intensity values (in dB) for each subject.

Age	Subject	Stressed Syllable		Unstressed Syllable	
		First	Second	First	Second
2	1	52.00	54.70	52.00	52.30
	2	49.30	48.50	53.30	44.60
	3	47.50	48.90	48.90	48.20
	4	48.40	46.50	49.70	50.30
	5	50.00	54.79	52.20	49.90
	6	50.10	54.00	52.20	50.30
	M	49.55	51.23	50.95	49.27
	SD	1.56	3.68	1.78	2.64
3	1	43.54	41.45	40.09	38.77
	2	50.00	49.90	47.60	45.20
	3	53.36	53.85	50.54	47.00
	4	54.75	49.56	47.44	45.50
	5	58.85	57.00	57.25	57.69
	6	54.45	62.75	54.25	48.55
	M	52.49	52.42	49.55	47.12
	SD	5.22	7.27	6.03	6.12
4	1	53.10	52.10	47.40	48.90
	2	54.50	54.93	53.20	51.50
	3	55.60	54.90	50.21	51.50
	4	54.00	55.40	49.63	48.64
	5	46.79	48.85	43.38	46.77
	6	46.92	52.54	40.08	48.54
	M	51.82	53.12	47.32	49.86
	SD	3.93	2.50	4.82	2.86

Table 4. Mean fundamental frequency values (in Hz) for each subject.

Age	Subject	Stressed Syllable		Unstressed Syllable	
		First	Second	First	Second
2	1	464.20	496.70	454.00	476.20
	2	325.80	317.20	367.30	297.50
	3	297.50	314.70	303.50	308.90
	4	289.50	250.00	275.80	300.60
	5	308.40	309.40	277.30	301.70
	6	353.40	316.00	326.70	388.70
	M	339.80	334.00	334.00	345.60
	SD	65.06	83.80	67.96	72.84
3	1	282.90	259.80	270.10	248.30
	2	279.25	293.11	238.11	250.08
	3	279.40	286.73	270.36	247.50
	4	335.50	334.56	263.22	259.38
	5	270.83	277.67	259.08	282.17
	6	359.46	435.25	275.75	269.00
	M	301.22	314.52	279.44	259.41
	SD	36.84	64.12	48.64	13.87
4	1	284.80	293.30	263.80	255.90
	2	269.30	272.30	225.40	258.50
	3	277.90	269.90	240.20	280.00
	4	255.30	273.55	255.80	235.00
	5	301.50	300.00	285.28	280.46
	6	442.10	407.08	291.58	319.08
	M	305.15	302.69	260.34	274.49
	SD	68.84	52.61	25.52	28.85

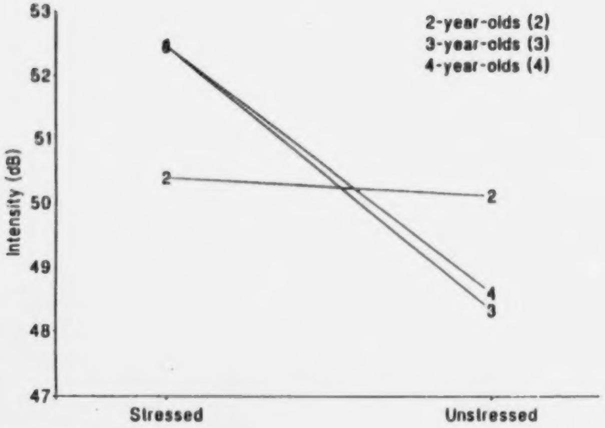

Figure 1. Two-way age by stress level interaction for intensity measure.

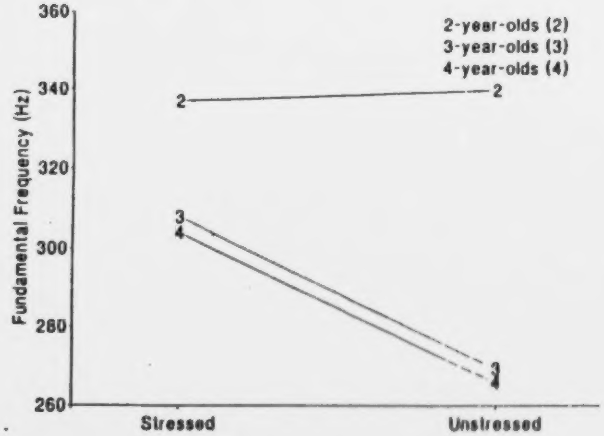

Figure 2. Two-way age by stress level interaction for frequency measure.

Table 5. Mean duration values (in cs) for each subject.

		Stressed Syllable		Unstressed Syllable	
Age	Subject	First	Second	First	Second
2	1	20.40	45.90	15.00	39.90
	2	23.60	37.80	22.50	33.90
	3	16.50	22.70	17.00	18.30
	4	14.20	26.50	17.50	15.70
	5	18.60	34.20	17.30	33.50
	6	19.60	31.70	20.80	17.50
	M	18.82	33.13	18.35	26.47
	SD	3.25	8.26	2.76	10.47
3	1	22.77	33.64	14.73	30.04
	2	22.40	36.10	15.00	17.47
	3	17.81	28.17	10.71	16.55
	4	19.25	34.81	14.25	17.00
	5	20.54	33.77	21.95	27.73
	6	16.32	22.00	8.50	14.73
	M	19.85	31.42	14.19	20.92
	SD	2.55	5.35	4.60	6.39
4	1	17.60	33.10	18.70	16.10
	2	22.40	36.10	15.00	19.47
	3	19.40	32.70	17.20	11.00
	4	18.10	35.10	21.90	8.40
	5	18.10	27.50	16.20	10.10
	6	15.20	40.00	24.50	16.30
	M	17.98	34.72	20.37	12.82
	SD	1.56	4.77	3.48	3.40

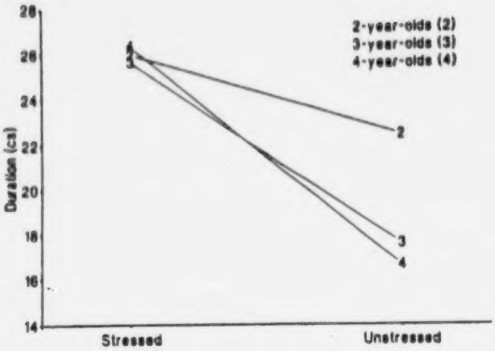

Figure 3. Two-way age by stress level interaction for duration measure.

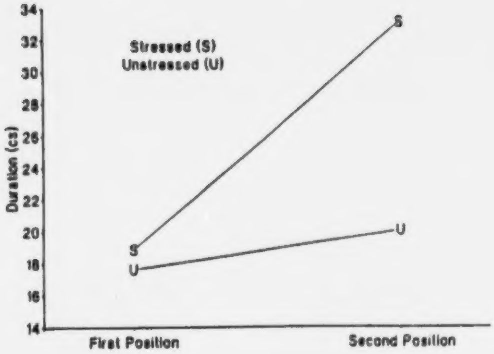

Figure 4. Two-way stress level by syllable position interaction for duration measure.

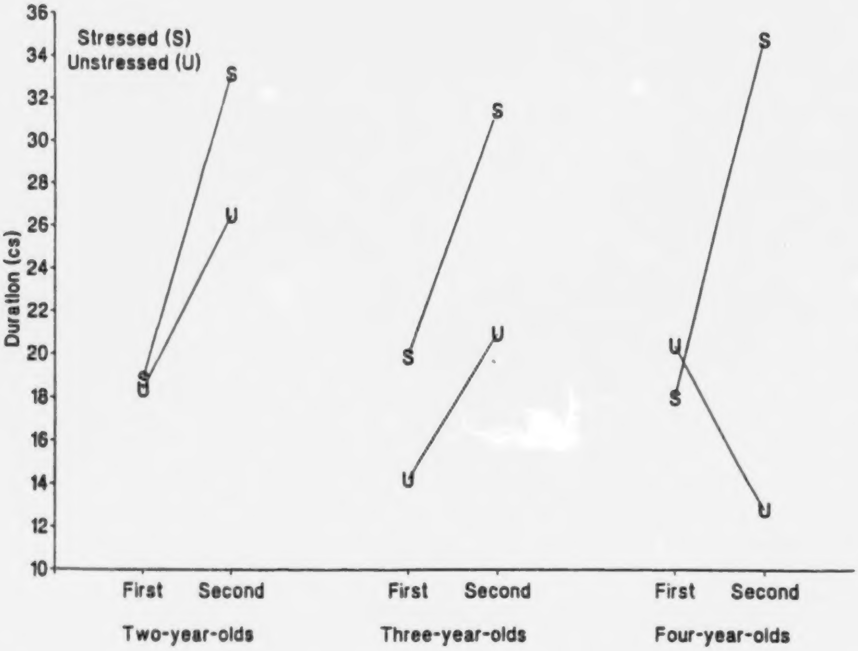

Figure 5. Three-way age by stress level by syllable position interaction for duration measure.

displays this interaction. For the two-year-olds, second syllables are still longer than first syllables, but stressed syllables are also longer than unstressed syllables, regardless of position. However, the difference between stressed and unstressed syllable duration appears greater in second position. For the four-year-olds, second syllables are longer than first syllables only if they are stressed. Second syllables are shorter when they are unstressed.

It is interesting to look at the absolute duration values for the 'CVCV targets. Across the age groups, the duration of the first vowel remains relatively constant, around 18 to 20 centiseconds. However, the absolute duration of the second vowel declines with increased age, from 26 cs at two years, to 21 cs at three years, and finally to 13 cs at four years, indicating that the children are learning to reduce the length of unstressed syllables.

Discussion

The results of the present study suggest that all three of the acoustic features measured (intensity, fundamental frequency, and duration) are rather poorly controlled at two years of age. At three years of age, both intensity and fundamental frequency are used consistently to mark the stressed syllable, regardless of its position in the word. However, it is not until four years of age that children seem to have control over duration as a feature for marking word stress.

The present data also argue for a neutral start hypothesis for early stress production. The two year olds produced changes in intensity and fundamental frequency on individual tokens, but not consistently any direction. Instances of incorrect stress placement were seen not only in the use of first syllable stress for second syllable stressed targets, as would be predicted by the trochaic hypothesis, but also in the use of second syllable stress for first syllable stressed targets, in direct opposition to the trochaic hypothesis.

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How Conservative are Children?: Evidence from Auxiliary Errors*

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Introduction. The auxiliary system has received considerable attention from linguists and researchers studying language acquisition. One of the reasons for this attention is that the behavior of auxiliaries is very complicated; while certain syntactic and semantic traits are associated with many auxiliaries, some auxiliaries do not exhibit these traits. Linguists have tried to address the question of why the auxiliary system is so complicated or, less ambitiously, how its behavior can be described. Researchers studying language acquisition have attempted to explain how children simultaneously learn the generalizations and restrictions on auxiliary order, combination, inflection, and placement (c.f., Baker, 1981, Pinker, 1984). In this paper, I will focus on how children acquire the auxiliary system.

The child learning the English auxiliary system could adopt various strategies. At one extreme, she could acquire the auxiliary system productively, generalizing what she knows about the behavior of one auxiliary to another auxiliary. If she is too productive, however, she will make many mistakes. Consider, for example, what would happen if she generalized the behavior of *do* to *can*. If she did, she might notice that in the sentence *he does not eat* the auxiliary *do* agrees with the subject *he* and from this erroneously conclude that *can* should also agree with its subject. This would cause her to say things like **he cans eat*. At the other extreme, the child could adopt a conservative strategy and refuse to make any generalizations about the behavior of auxiliaries. She would learn the entire auxiliary system by rote, producing only those constructions which had been positively attested to in the input. If she adopted this strategy, she would make no errors. However, her acquisition of the auxiliary system would be extremely slow and protracted since she would never transfer what she knows about one auxiliary to another auxiliary.

In this paper, I make the following 3 point argument. In Section 1, I argue that the auxiliary system is so complicated that, if children were to generalize from one auxiliary to another, they would almost certainly make errors. In Section 2, I present the results of a search of a large corpus of children's speech which indicates that inversion errors are the only type of auxiliary error that children make with any appreciable frequency. In Section 3, I argue that the paucity of most types of auxiliary errors suggests that children acquire most aspects of the auxiliary system conservatively.

1. Description of the Auxiliary System

The following review of the auxiliary system is not meant to be a complete summary of the linguistic behavior of the auxiliary system. Rather, it is designed to give the reader a feel for the complexities of the auxiliary system.

Types of auxiliaries.

There are 5 basic kinds of auxiliaries. The first subtype is the progressive *be* (e.g., the *is* in

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she is eating). The second subtype is the passive *be* (e.g., the *was* in *he was killed*). Not all instances of *be* are auxiliaries, however. For example, the *is* in *she is happy* is a copula, not an auxiliary. Likewise the action proverb *being* in *she was being naive* is not an auxiliary. The third subtype of auxiliary is the aspectual *have* (e.g., the *have* in *they have been eating*). Again not all instances of *have* are auxiliaries. The *have* in the sentence *they have food* is a main verb denoting possession. The fourth subtype of auxiliary is the auxiliary *do* (e.g., the *do* in the sentence *I do not eat*). The auxiliary *do* must be distinguished from the proverb *do* found in sentences like *I do this*. The fifth subtype of auxiliaries are the modal auxiliaries. The modals include *can*, *could*, *will*, *would*, *shall*, *should*, *may*, *might*, and *must*. The modals *can* and *will* must be distinguished from their homophonic main verb counterparts such as those found in the sentences *he canned peas* and *he willed her to come*.

In addition to these true auxiliaries, there are a group of verbs that exhibit some isolated auxiliary-like traits. I will refer to these verbs as pseudoauxiliaries. Examples of pseudoauxiliaries include the verbs *need*, *better*, *gonna*, *wanna*, and *gotta*. In many ways pseudoauxiliaries semantically and syntactically resemble modal auxiliaries. One can say, for example, *you better go*, *you better not go*, *you better be going*, *you better have been going*, etc.. If one replaces the word *must* for *better*, the resulting sentences have the same structure and similar meaning as the sentences with *better*. Notice, however, that every pseudoauxiliary lacks certain behaviors which most modal auxiliaries exhibit. For example, *need* must be negated (e.g., one can say *you need not go* but not **you need go*). In addition, most pseudoauxiliaries cannot appear before a negation marker (e.g., **you gonna not go*, **you gotta not go*, etc.). Finally, no pseudoauxiliary can appear before a subject (e.g., **better you go?*, **gonna you go?*, etc.).

Restriction on auxiliaries

For ease of exposition, I will divide the restrictions on the behavior of auxiliaries into 4 types: inflectional restrictions, combination restrictions, order restrictions, and inversion restrictions.

Inflectional restrictions. With the exception of modal auxiliaries, all auxiliaries agree with their subjects (subject-verb agreement, or SVA). Thus, for example, one can say *she is going* but not **she are going*. A second inflectional restriction is that the only auxiliary that can take the progressive *-ing* inflection is the passive *be* (for example, the *being* in *he is being traded to the Mets*). One can't say **musting*, **ising*, **didding*, or **hadding*. Furthermore, while *having*, or *doing* are acceptable, they are acceptable only as main verbs.

Combination restrictions. In general, most of the possible combinations of auxiliaries are not acceptable. For example, one can say *I could have eaten a horse*, but one cannot say **I could eaten a horse*. Even within subtypes of auxiliaries, some combinations are acceptable whereas others are not. For example, the combination of modal + aspectual *have* is acceptable for all modals except *can*. Sentences like **I can have eaten*, **I can have been eating*, **I can have been kicked*, and **I can have been hungry* are unacceptable even though these same sentences would be grammatical with any other modal. Another example of restrictions within a subtype of auxiliary is the cliticization of the negation marker *not*. The contracted form of *not* (*n't*) can cliticize onto all forms of *be* except *am* (i.e., one can say *isn't*, *aren't*, *wasn't*, *weren't*, but not **amn't*). Among the forms of the auxiliary *do*, only *don't* is irregular (i.e., one says *didn't* and *doesn't* but not **do-n't*). All of the modals except *will*, *shall*, and *may* have regular contracted forms (i.e., one cannot say **willn't*, **shalln't*, and **mayn't*).

Order restrictions. The subtypes of auxiliaries are strictly ordered as follows:

<MODAL> <HAVE> < PROGRESSIVE BE> <PASSIVE BE>

One can best appreciate this ordering in sentences which contain all of the subtypes of auxiliaries. Consider, for example, the sentence *he must have been being tortured the entire time he was in jail*.

Notice that if one switches the order of any of the auxiliaries, the sentence is ungrammatical (e.g., **he must have being been tortured* . . . , etc.). A second order restriction is that if there is a tense or SVA inflection, it must appear on the first auxiliary. A third restriction is that, if the content of the entire sentence is to be negated, the negation marker must follow the first auxiliary.[1]

Inversion Restrictions. Lastly, there are restrictions which determine whether a subject appears before an auxiliary or whether the order is inverted. In questions, the left-most auxiliary and the subject invert in matrix questions but not in embedded questions or in *how come* questions.[2] Thus, for example, *when can he go?* is a grammatical matrix question, whereas **when he can go?* is not. In embedded questions and *how come* questions the auxiliary and subject do not invert. Thus, *I wonder if he can go* and *how come he can go?* are grammatical, whereas the inverted **I wonder if can he go* and **how come can he go?* are ungrammatical.

Things are not that simple, however. The first complication is that some non-auxiliaries can invert. In all modern dialects of English, the copula inverts. Thus, one can say *is she happy?* even though *is* is not strictly an auxiliary. If the inversion rule were simply that only the first auxiliary can invert, we would expect *do*-support to be necessary. In other words, we would expect **does she be happy* to be the grammatical way to question the sentence *she is happy*. Additionally, in United Kingdom dialects of English, the main verb *have* can invert (e.g., *have you a match?*).[3] A second complication is that most pseudoauxiliaries cannot invert (e.g., **better you go?*, **gonna you go?*, etc.).

The above suggests that the behavior of auxiliaries is extremely complicated. The auxiliary system seems to be filled with linguistic landmines waiting for the child who makes the wrong generalizations. Before I proceed to examine the errors children make, I will give a few examples of generalizations a child learning English might make and the errors that would result from these generalizations. First, based on the prevalence of auxiliaries that are homophonic with main verbs (see above), the child might conclude that there was no difference between main verbs and auxiliary verbs. If she did this, she would make many errors. One type of error which is uniquely predicted by this model, is that she would either invert main verbs (if she generalizes the behavior of auxiliary verbs) or not invert auxiliary verbs (if she generalizes the behavior of main verbs). Another possibility is the child might notice that all auxiliaries exhibit subject-auxiliary inversion and from this conclude that all auxiliaries belong to a single subtype. If she did this, she would not make the inversion errors above, However, we would still expect her to either fail to add the SVA marker to nonmodals (if she generalized the behavior of modals) or add it to modals (if she generalized the behavior of nonmodals).

Based on the fact that *be*, *have*, and *do* exhibit SVA whereas the modals do not, the child might decide that *be*, *have*, and *do* all belong to a single subtype of auxiliaries which is distinct from the modal subtype. If she did this, she would not make the SVA errors outlined above. However, she would still use illicit combinations and orderings of the *be*, *have*, and *do* auxiliaries. This would happen because sentences like *he must have been being tortured* would lead her to conclude that English permits a sentence to contain up to three members of the *be-have-do* subtype. Hence, she would produce ungrammatical sentences like **I had have going*, or **I being been tortured*.

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[1] One can say, for example, *I could have not been late*, but semantically what seems to be negated isn't the entire utterance, but rather the "been late" portion.

[2] The auxiliary can also occur before the subject in exclamatives (e.g., *can she cook!*) and negative polarity sentences (e.g., *Never have I seen such a mess*). Because these forms are very rare in early speech, they will not be discussed.

[3] It probably isn't the case that U.K.-English possessive inverts because it is a full-fledged auxiliary. Unlike a true auxiliary, it can appear as the sole verb in a sentence (e.g., *they have apples*). Furthermore, sentences in which possessive *have* precede an uncontracted *not* sound stilted at best (e.g., *?*I have not any apples*).

2. Auxiliary Errors Made by Children

In Section 1, I outlined some of the types of auxiliary errors we would expect children to make if they generalized the behavior of one auxiliary to another auxiliary. I conducted analyses of the auxiliary errors in children's speech to determine which, if any, auxiliary errors children make.

Corpus. I searched for auxiliary errors in the ChiLDES transcripts (MacWhinney and Snow, 1985) of the 14 children shown in Figure 1. I used the UNIX utility "fgrep" to cull all of the children's lines which contained an auxiliary or a negation marker.[4] This yielded a corpus which contained approximately 55,700 uses of auxiliaries[5] and 15,000 uses of negation markers.

Figure 1: Child Transcripts Analyzed

Corpus collected by	Child	Age range	Approx. # of Aux's
Bloom (1973):	Allison	1;4-2;10	200
	Peter	1;10-3;2	5,200
Brown (1973):	Adam	2;3-5;2	11,600
	Eve	1;6-2;3	1,800
	Sarah	2;3-5;1	6,900
Clark (1978):	Shem	2;3-3;2	2,500
Higginson (1985):	April	1;10-2;11	1,200
	June	1;3-1;9	200
	May	0;11-0;11	0
MacWhinney & Snow (1985):	Mark	1;5-6;0	2,100
	Nathan	2;6-3;9	1,700
	Ross	2;10-7;10	11,700
Sachs (1983):	Naomi	1;2-4;9	3,100
Suppes (1973):	Nina	2;0-3;3	7,500
Total number of auxiliaries			55,700

Procedure. I went through the corpus of utterances which contained auxiliaries or negation markers looking for mistakes involving auxiliaries or negation. In addition, for each question that contained a subject and an auxiliary, I determined whether the auxiliary was inverted. Utterances that had contracted, stuttered, or unclear auxiliaries and utterances which were obvious routines or imitations were not included in the error analyses or inversion analyses. An undergraduate research assistant did

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[4] The computer searched for lines which contained the following letter strings: *am*, *are*, *be*, *better*, *can*, *could*, *do*, *did*, *gonna*, *gotta*, *had*, *has*, *have*, *is*, *may*, *might*, *must*, *need*, *never*, *no*, *not*, *n't*, *shall*, *should*, *was*, *were*, *will*, *won't*, and *would*.

[5] Note that occurrences of copula *be*, and main verb *have* and *do* are included in these tallies.

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the same analyses for a subset of the auxiliary and negation corpus. For all analyses, the concordance ratings were greater than 90%.

Results

A Inflectional Errors.

Illicit Inflectional Endings. There was only one example of a child appending an illicit inflectional marker to an auxiliary. Children never applied the SVA marker to modals (i.e., there were no examples like **he cans go*). Likewise, children never applied the progressive *-ing* inflection to a modal (i.e., there were no examples like **musting*). Furthermore, while the children frequently said *doing*, *being*, and *having*, there was one example in which a child added the progressive inflection to an auxiliary *do*, *have*, or *be* (Eve 2;0: while me [/] while me being sitting on it).

Overregularization. Many auxiliaries have past tense and SVA forms which are irregular. Notice, for example, that one says *she was eating* rather than **she be-d eating* and *she is eating* rather than **she be-s eating*. It is well-known that children often go through a stage during which they say "eated" for "ate" and "sayes" for /sez/ (c.f., Pinker & Prince, 1988, for a review). Unless children are completely conservative in their acquisition of auxiliaries, we would expect them to occasionally produce overregularized past tense and SVA forms. I found no such examples. Children made no errors with modals (i.e., they never said "canned" for "could"). I found 28 overregularized forms of *do*, *have*, and *be*, but in all 28 cases the overregularized verb was a main verb and not an auxiliary. In addition, I found 134 cases in which children used *be* where they should have used *is*, *are*, or *am*. In 128 of 134 examples, *be* was a copula and not an auxiliary.

In summary, the children made essentially no inflectional errors with auxiliaries. They made no auxiliary errors despite the fact that they inflected and overregularized main verbs which were homophonic to auxiliaries.

B. Combination Errors.

Illicit Combinations of Auxiliaries. As was discussed in Section 1, most combinations of auxiliaries are not allowed. Despite this fact, there were only 30 cases of what appear to be illicit combinations of auxiliaries in questions. All of the examples of illicit auxiliary combinations in questions involved having an auxiliary both before and after the subject. Thirteen of the 30 examples had the copula *be* (e.g., Adam (3;4): is it was a snake?) rather than a "true" auxiliary. Among declarative sentences, there were only a half dozen cases which could be examples of illicit combinations of auxiliaries. All but one of these examples involved a copula (i.e., all but one were similar to Adam (2;7): you don't be quiet). Given that the combination modal+aspectual *have* is acceptable for all modals except *can*, one might expect that errors like **I can have gone* would be particularly common. This was not the case. I found 40 modal+aspectual *have* utterances but none of them used the modal *can*. This is despite the fact that the children used *can* more frequently than any other modal.

Illicit Combinations of Auxiliaries and Inflections. In addition to most combinations of auxiliaries being ungrammatical, most combinations of auxiliaries and inflected main verbs are unacceptable. Therefore, I searched for ungrammatical combinations of auxiliaries and inflections. I only counted examples which were ungrammatical because of the presence of an extraneous inflection or auxiliary (e.g., Adam (2;7) cowboy did fighting me).[6] I found that fewer than 0.1% of children's questions were double-tensed. Double-tensing was even rarer among declaratives. Furthermore, there were 10 cases like **does she going?* where *do*-support was incorrectly provided in questions. Likewise, judging from context, there were fewer than 20 cases where children incorrectly provided a *do* in an unemphatic declarative sentences. In other words, there were very few examples like *I do taste dem* (Sarah; 3;0).

Auxiliary + *n't*. The negation marker can cliticize onto most but not all auxiliaries; **amn't*, **do-n't*, **mayn't*, **shalln't*, **willn't* are not acceptable. I found only one case of *amn't* and one case of *willn't* among the almost 15,000 uses of negation markers.

In sum, there were very few illicit combinations of auxiliaries despite over 55,000 possible opportunities. The frequency of children's auxiliary combination errors does not appear to be dramatically greater than what one would expect to find in adult speech. When adults make auxiliary combination errors, these errors are obviously production errors and not the result of a faulty grammar. Since children's errors are no more frequent than adult errors, one could argue that they are production errors just like the adult errors.

C. Word Order Errors Other than Inversion Errors.

Auxiliary Order. In utterances that had more than one auxiliary, children never scrambled the relative order of the auxiliaries.

Misplaced Inflection. In all but 10 of the children's utterances which had auxiliaries and a tense or SVA inflection, the inflectional marker appeared on the first auxiliary.

Negation. Children placed a negation marker after a main verb in only 5 utterances. In other words, they essentially never said things like **he taking not all of de walls down* (Adam, 3;5).

D. Inversion Errors

Which Verbs Can Invert. There were no examples of the children inverting pseudoauxiliaries. In other words, they never asked questions like **Better I go?* In addition, I found only 10 questions in which children inverted a main verb (e.g., *where goes one?*). Conversely, children never placed *aren't* after *I* (e.g., **I aren't going*) even though there were 22 questions in which children placed *aren't* before *I* (e.g., *Aren't I going?*).

What Settings Allow Inversion. The children sometimes failed to invert in settings which require inversion. In 8% of the matrix questions that had auxiliaries, children placed the subject before the auxiliary (e.g., Adam (3;3): What I will read?). Furthermore, all of the children who asked at least 25 questions with auxiliaries made this mistake at least once. The children also sometimes inverted where they shouldn't have. They inverted subject and auxiliary in 6% of the embedded questions that had auxiliaries (e.g., Adam (4;3): I wonder what are dese for?). In addition, they inverted subject and auxiliary in 14% of how come questions that had auxiliaries (e.g., Adam (4;10): How come is dat?).

In summary, inversion errors were by far the most common and pervasive type of auxiliary error. However, not all possible types of inversion errors occurred. For example, the children essentially never inverted verbs which are uninvertible. They did make two types of inversion errors: they occasionally neglected to invert in settings that required inversion, and they permitted inversion in settings that do not allow inversion.

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[6] I did not count examples which were ungrammatical because an inflection or an auxiliary was missing (e.g.,**she playing* or **she is play*) because such examples are likely to be the result of a production constraint.

3. Discussion

In Section 1, I argued that the linguistic behavior of auxiliaries is so complex that, if children generalized from one auxiliary to another, they would almost certainly make errors. In Section 2, I presented the results of analyses of over 55,000 spontaneous uses of auxiliaries by children. The results of these analyses suggest that inversion errors are the only type of auxiliary error that children make with any appreciable frequency. I would like to argue that the scarcity of most types of auxiliary errors suggests that children acquire most aspects of the auxiliary system conservatively. It is possible that this pattern of errors reflects different acquisitional strategies. These different acquisitional strategies might in turn reflect a linguistic difference between most of the properties associated with the auxiliary system and auxiliary inversion.

This pattern of errors is consistent with the following linguistic model. The lexicon could contain a list of which inflected forms, combinations, and orders of auxiliaries are acceptable.[7] The lexicon could also contain a list of which auxiliaries can invert. Because these lists are finite, children could learn them essentially by rote. It is not possible, however, to list all of the sentence strings which permit the auxiliary to appear before the subject (e.g., *is the man eating*, *is the big man eating*, *is the big ugly man eating*, etc.). Inversion seems to be the result of a syntactic process which can occur in some settings and not others. Whether an invertible auxiliary does invert depends on restrictions on when this syntactic process can occur. Children must learn what these restrictions are.

The rarity of most types of auxiliary errors is consistent with children acquiring the auxiliary system in a conservative fashion. The lack of errors does not, however, prove that children are conservative learners. It could be that children do generalize, but that they are either extremely lucky or the generalizations they make are fairly conservative. Given that I searched over 50,000 uses of auxiliaries for errors, it is unlikely that the children just happened not to make most of the possible types of errors. A more likely possibility is that children are extremely smart about the generalizations they make. Notice that all the members of the *be* subtype, the *do* subtype, and the *have* subtype behave pretty much like one another. Children could fairly safely generalize within each of these subtypes.

The modal subtype, on the other hand, poses a number of problems for generalization. One problem with generalizing within the modal subtype is that the pseudoauxiliaries (which by definition lack certain auxiliary-like traits) behave most like the modals. If children generalize the behavior of modals to pseudoauxiliaries, they would do things like invert pseudoauxiliaries. Alternatively, if they generalized the behavior of pseudoauxiliaries to modals, they would fail to invert modals. A second problem with the modals is the fact that utterances with *can* + aspectual *have* are unacceptable even though every other modal can be combined with aspectual *have*. If children were wary about generalizing within the modal category, they would be able to avoid these potential errors.

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[7] Schachter (1983) and Pinker (1984) have suggested that one feature determines which inflectional forms, combinations and orders of auxiliaries are acceptable. If they are right, then the lexicon would merely have to list the values for this one feature. This would simplify the lexicon and, hence, acquisition. It would also lead one to expect that inflection, combination and order errors would cluster.

Negation presents another serious problem for the nonconservative learner. First, some auxiliaries can only appear with negation markers. For example, one can say *you need not go*, but one cannot say **you need go*. Second, the negative marker cannot cliticize onto *am* or *may*, and *shall* and *will* have irregular negated forms. Third, *aren't* can appear before the pronoun *I* but not after it (e.g., *aren't I going?* but not **I aren't going*). Finally, certain negated forms of auxiliaries have different connotations depending on whether they appear before or after the subject.[8]

In the transcript analyses, I found that the children overregularized past tense and SVA inflections for *be*, *do*, and *have* when *be*, *do*, and *have* are main verbs but not when they are auxiliary verbs. This suggests that from a very early age they distinguished main verbs from auxiliary verbs. It also suggests that they applied a productive learning strategy to main verbs and a conservative learning strategy to auxiliary verbs. How were they able to distinguish main verbs from homophonic auxiliary verbs? Perhaps they were able to distinguish main verbs from auxiliary verbs because the two classes of verbs are part of Universal Grammar. It is even possible that the different subtypes of auxiliary verbs are part of Universal Grammar. To the extent that children are born expecting to encounter different categories of verbs, they might be able to use a productive learning strategy without making many errors.

In summary, the analysis of children's auxiliary errors provides little or no evidence of a productive learning strategy. However, it may be that there are no errors because children make exactly the right generalizations. In addition to looking at auxiliary errors, one may be able to determine whether children are conservative or productive by examining the acquisitional time course for the various auxiliaries. For example, one could determine whether all of the members of an auxiliary subtype exhibit certain linguistic behaviors at the same time. One could also determine whether auxiliaries that are acquired late immediately exhibit all of the traits associated with that subtype of auxiliary or whether these traits have to be learned anew for each new modal. These analyses would complement the error analyses presented here. Together they should help reveal how conservative children are in their acquisition of the auxiliary system.

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[8] Compare, for example, the meanings of *won't* in *you won't go* and *won't you go?*

CHILDREN'S PRODUCTION OF SUBJECTS: COMPETENCE, PERFORMANCE, AND THE NULL SUBJECT PARAMETER

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When and how do children determine that their language does or does not require overt surface subjects? English requires an overt subject. For example (taken from Hyams, 1986), in English, (1) is grammatical while (2) is not allowed. In contrast, in Italian, both (3) and (4)

(1) I am going to the movies
(2) * Am going to the movies

are allowed. There can be an empty or "null" subject in Italian.

(3) Io vado al cinema
I am going to the movies
(4) Vado al cinema
Am going to the movies

English and French are among the languages that require overt subjects; Italian and Spanish are among the languages that allow null subjects. The null subject parameter may also control other features of language features in addition to whether an overt subject is required (for a list of candidates, see Riemsdijk and Williams, 1986: 298-303). For example, languages that allow null subjects typically do not have "expletive", or referentially empty, pronouns.

An example, in English, of a referentially empty pronoun is the "it" in (5). In Italian, such a non-referential form of "it" does not

(5) It seems that Jane loves Mary
(6) Sembra que Jane ama Mary
Seems that Jane loves Mary

exist. The only equivalent of (5) in Italian is (6). Expletive "it" also occurs in "weather" expressions: "It's raining," "It's snowing," "It's cold," and so on.

The acquisition of the null subject parameter has received much recent attention, beginning with Hyams's (1986) original and provocative analysis. Hyams offered an explanation for an apparently ubiquitous phenomenon in American children's early speech: subjects are often absent. The sheer ubiquity of this phenomenon, which has never received a satisfactory explanation, made it an excellent candidate for study.

Hyams's (1986) explanation was that American children began acquisition with the null subject parameter set at the wrong value, the value which optionally allowed null subjects, and entailed other grammatical consequences. In addition to explaining why American children frequently omitted subjects, Hyams's (1986) account simultaneously explained other features of children's speech that apparently cooccurred with subject optionality. For example, her account predicted that children who omitted subjects would also fail to use expletive subjects when they were required, and that expletives would enter the children's repertoire at the same time that subjects were used as required. In addition, her account predicted that children would fail to use Modals until they used subjects consistently. Previously reported data appeared to confirm both predictions.

What was so attractive about Hyams's (1986) analysis was that it accounted for a diverse body of phenomena under one theory. The theory provided both a linguistic analysis of the null subject parameter, and an account of acquisition based on the linguistic analysis. There have since been a variety of competing explanations for American children's inconsistent use of subjects.

Surprisingly, however, there are no numerical data bearing on American children's use of subjects. Although Hyams (1987) states that "it is well-known that thematic (referential) lexical subjects are optional in early child language and that expletive subjects are entirely lacking," that statement is incorrect. Existing accounts use either summary data reported in other contexts, or data from very small samples of children. This study presents the first quantitative data on American use of subjects, and the first comparison of American and Italian children's production of subjects.

The data show that children's use of subjects has been erroneously described. Further, none of the current competence accounts of acquisition of the null subject parameter is supported. Finally, the data raise difficult methodological questions about the interpretation of inconsistent usage by children.

Cross-sectional American data and longitudinal Italian data are compared. Twenty-one American children were audiotaped in conversations with their mothers, typically on two occasions no more than two weeks apart, for about 1 and 1/2 hours total. The children ranged in age from 1;10 to 2;8. MLU was computed from each taping session, and the average MLU was used. This average MLU ranged from 1.53 to 4. The children were divided into 4 unequal groups on the basis of their MLU distribution. Group I consists of 5 children between MLU 1.53 and 1.99. Group II consists of 5 children between MLU 2.24 and 2.76. Group III consists of 8 children between MLU 3.07 and 3.72. Group IV consists of 3 children between 4.12 and 4.38. In this sample of children MLU and age were highly correlated, r = .74.

The children's speech was coded, and several categories were excluded from further analysis: utterances with unintelligible portions, single word assents or dissents, imitations, and routine utterances. In addition, for the analyses here, imperatives without subjects were excluded. Utterances were classified as imperatives on the basis of context.

Table 1 shows what percentage of the children's non-imperative, non-imitative, utterances with verbs contained subjects. The five children in Group I, between MLU 1.53 and 1.99, used subjects close to 70% of the time when they produced utterances containing verbs. There is a shift in percentage of usage between Group I and Group II. Group II, whose MLUs range between 2.24 and 2.76, used subjects close to 90% of the time. Performance was consistently high thereafter, increasing slightly in the next two groups. As the standard deviation indicates, Group I was the most variable group.

The high consistency of usage in Group II suggests that children with an MLU of 2.5 or less understand that English requires subjects, and can consistently express that understanding in their speech, if we take 85-90% usage to be consistent usage. "Earliness" is in the eye of the beholder, but such a high level of usage at this MLU indicates that, even in "early" child language, American children understand that their language is not a null subject language.

The next question is how to interpret the 70% average figure for Group I, especially considering the variability in this group, where two children had subject use as low as 55%. There are two possibilities. One is that the child has not yet established the correct value. The child could think either that subjects are optional, or could be unsure about whether subjects are optional or obliatory. Either way, on possibility one, the child's competence is deficient. The second possibility is that the child understands that subjects are required, but is unable to express that understanding in her speech. On possibility two, the child's performance is deficient.

How can one decide between the two possibilities? Two strategies can be used. One is to explore both competence and performance factors within English. The other is to compare English-speaking children with children of a null subject language. The American data suggest that a performance explanation can handle all the facts, a conclusion supported by the Italian data, which show that American and Italian children differ markedly in their productions.

To begin with the American children, we can examine other properties that the children's speech should have if they understand that subjects are obligatory, using the higher-MLU children as a benchmark. If Group I children believed their language was a null subject language, one might expect them to use particularly few pronominal subjects, since it is pronominal subjects that can be omitted. The subjects that are expressed should be lexical rather than pronominal. Instead, a majority of Group I children's subjects are pronouns - 77%. Pronouns included personal pronouns, demonstratives, and interrogatives. Pronoun use continues to be high, comprising 87% of Group II's subjects, 85% of Group III's, and 84% of Group IV's.

Another potential competence measure is production of the expletive "it". But if our benchmark is the higher-MLU children, expletive usage cannot serve as a measure. For all 4 groups of children, even those who are consistently producing subjects, there is little expletive usage, and little usage of expletive contexts. Children of this age and at this level of development are seldom interested in talking about the weather. Other contexts that would support expletive usage require embedded structures that are not within the children's repertoire.

To the extent that there is use of expletives, it occurs across the board. For example, the lowest MLU child produced an expletive: "When it's noe-y," where "noe-y" equals "snowy" or "snowing". In fact, that was this child's only production of the word "it". Since even the contexts in which expletives would be required are rare, the lack of expletives is not meaningful.

A third competence measure is presence of Modals, which, on some theories of the null subject parameter, could be related to production of subjects. Only the lowest MLU child failed to produce Modals. All others produced them, though usage was infrequent in Group I. Table 2 shows Modal usage for each group. Usage is expressed by using the number of strings with Verbs as a baseline. Thus, the figures show what proportion of strings with Verbs included a Modal. Modal usage increases as a function of age and MLU, but there is no hint of a step function. That is, Modal usage does not suddenly begin when subject use becomes consistent, nor dramatically increase when subject use becomes consistent. Nor is Modal usage is correlated with subject usage, once MLU and age are partialled out ($r = -.03$). Children's use of subjects is roughly constant regardless of how many Modals they produce.

What about performance measures? The data I will report here complement P. Bloom's (1989). If children's usage of subjects is tied to their overall development and ability to produce longer and longer utterances, then there are certain correlations one might expect. For example, MLU, age, and subject use should correlate, and they do. In this sample, the simple correlation between MLU and subject use is .77 ($p < .001$), and the simple correlation between age and subject use is .74 ($p < .001$). When a partial correlation between MLU and subject use is computed, the correlation is .48 ($p = .03$). Thus, the data suggest that children use subjects more as their MLU increases.

Another performance measure concerns correlations between Verb usage and subject usage. As Table 2 shows, children's Verb usage increases markedly from Group I to Group IV. Verb usage, unlike Modal usage, is highly correlated with subject usage, even when MLU and age are partialled out, $r = .78$, $p < .001$. As children produce more utterances with Verbs, they correspondingly produce subjects for those Verbs. Notice that Verb production is theoretically independent of subject use as measured here. The children could maintain a constant proportion of subject usage as their Verb production goes up.

The fact that subject usage and Verb usage are linked across the entire range of children suggests that children know that Verbs require subjects. As they are able to handle the complexity involved in including Verbs, they are correspondingly able to handle the complexity involved in including subjects. If the children believed that subject use was optional, their usage should remain roughly constant even though Verb usage increases.

A final factor can be introduced to account for Group I's inconsistent production of subjects. Although subjects are grammatically required in English, in some contexts speakers omit subjects. An example from the NY Times is, "Seems like she always has something twin-related perking." Other examples are "Want your lunch now?", "Having a good time?". The American child hears examples of subject omission, and has to determine just what contexts acceptably allow omission (for more discussion, see Valian, 1989).

To summarize, the child operates under performance limitations. She can also infer that it is acceptable to omit subjects in certain contexts (because she hears strings without subjects), without yet having zero'ed in on the contexts that support omission (because they are very complicated). As a result, subjects are absent too frequently.

The second strategy for assessing the significance of American children's very early inconsistent usage is to compare the children's performance with that of young speakers of a null subject language. Mazuka, Lust, Wakayama, and Snyder (1986), for example, looked at early Japanese usage. Italian data, consisting of longitudinal transcripts collected by G. Tirondola, and lent to me by F. Antinucci, provide an appropriate contrast. There are 5 Italian children, each 1;6-1;7 at the start of taping. They were recorded monthly for a year, except for one summer break, which occurred after the 5th taping. Each recording session was short, about 15-30 minutes. Because so few utterances are available, the 11 sessions are divided into Time I and Time II.

Time I covers the first 5 months, before the summer break. The children were about 1;6 to 1;10 during that time. Time II covers the last 6 months, after the summer break. The children were 2;0 to 2;5 during that time. The Italian children at Time II were thus on the average somewhat older than the American children in Group I, who averaged 2;0. However, it would be desirable to have a linguistic way of comparing the children. Since MLU cannot be calculated in the same way with Italian children as with American children, it was not computed. We did calculate the number of utterances with Verbs, in the same way that we had for the American children. At Time I, 27% of the Italian children's utterances contained a Verb. That was the percentage for the American children in Group I. At Time II, 39% of the Italian children's utterances contained a Verb.

At both Time I and Time II, the Italians differ from even Group I Americans. Table 3 shows the children's use of subjects. The total proportion of non-imperative non-imitative strings containing subjects stays constant at about .30, less than half the average usage of Group I Americans. This shifts what has to be explained about the American data from, why do Group I Americans use subjects so little, to, why do Group I Americans use subjects so much? The comparison suggests that Group I Americans already understand that subjects are syntactically required.

To continue with the Italian children, at Time I the Italian children produce twice as many post-verbal as pre-verbal subjects, echoing Bates (1976). This may reflect the children's initial comprehension that overt post-verbal subjects carry focus information. By Time II the children have doubled their production of pre-verbal subjects, but total production of subjects remains the same from Time I to Time II. Again the Italians differ from the Americans, in that they do not increase their overall rate of subject production, within the time period sampled.

The Italian children also produce less than half as many pronominal subjects as the American children. Recall that for Group I of the American children, about 75% of the subjects were pronouns. At Time I 22% of the Italian children's subjects were pronouns, and at Time II 35% were pronouns. At both Times I and II, pronouns were more common in post-verbal than pre-verbal position. This, again, may reflect the fact that post-verbal subjects tend to be the focus.

With respect to expletive contexts, the Italian children did produce a few verbs that demanded the absence of a subject. At Time I there was one instance; at Time II there were a total of 14 instances, produced by 4 of the 5 children, involving 3 verbs: bisognare, piovere, bastare. While this is a low rate of production, it is more frequent than is the case for the American children. This may, however, reflect the meanings of 2 of the 3 verbs: bisognare has to do with there being a need for something, and bastare with there being enough of something.

With respect to Modals, the Italian children produced many fewer than the American children. At Time I there was one occurrence; at Time II 3 of the 5 children produced 7 examples. If Modal use is relativized to Verb use, as it was with the American children, that is a total of 6/392 non-imperative utterances with Verbs, or a proportion of .015, about half the American production.

In sum, the lowest-MLU group of American children does not look anything like either Time I or Time II Italian children. The American children produce, from the beginning, more subjects, more pronominal subjects, and more Modals. By itself, such data are not definitive, since the children may be matching the adult frequencies of usage. American children could think English is a null subject language, where the option of omitting the subject is infrequently used by speakers. What makes that interpretation less likely, however, is the fact that all children operate under production constraints. If American children believed their language was a null subject language, and needed to select constituents to omit, subjects would be an excellent choice, even if the adult frequency were high.

Thus, it is hard to explain the differences between American and Italian children if we assume that both language groups think subjects are optional, and if we assume that both language groups operate under production constraints. If we instead conclude that even the lowest MLU group of American children understands that subjects are syntactically required in English, we can explain their inconsistent usage as due to two factors: production constraints plus the existence of acceptable strings in English that lack subjects.

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Table 1

American Children
Proportion of Non-Imperative Non-Imitative Utterances Containing a Verb Which Also Contain a Subject

Mean MLU MLU Range	Mean Age Age Range	Mean Proportion Subject (s.d.) Proportion Subject Range
Group I (N = 5, Mean of 86 utterances with a Verb per child)		
1.77 1.53-1.99	2;0 1;10-2;2	.69 (.12) .55 - .82
Group II (N = 5, Mean of 207 utterances with a Verb per child)		
2.49 2.24-2.76	2;5 2;3-2;8	.89 (.04) .84 - .94
Group III (N = 8, Mean of 286 utterances with a Verb per child)		
3.39 3.07-3.72	2;5 2;3-2;6	.93 (.04) .87 - .99
Group IV (N = 3, Mean of 250 utterances with a Verb per child)		
4.22 4.12-4.38	2;7 2;6-2;8	.95 (.03) .92 - .97

Table 2

American Children's Modal and Verb Usage

	Subject Usage	Modal Usage[a]	Verb Usage[b]
Group I	.69	.03	.27
Group II	.89	.06	.52
Group III	.93	.09	.70
Group IV	.95	.14	.79

Note. In all cases, strings with unintelligible segments, single word assents or dissents, imitations, or imperatives, were excluded.

[a] For Modal Usage, the numerator is number of Modals and the denominator is number of strings with Verbs.

[b] For Verb Usage, the numerator is number of strings with Verbs and the denominator is number of strings.

Table 3

Italian Children

Proportion of Non-Imperative Non-Imitative Utterances Containing a Verb Which Also Contain a Subject

Pre-Verbal (range)	Post-Verbal (range)	Total (range)
Time I (N = 5, Mean of 39 utterances with a Verb per child)		
.09 (.05-.19)	.21 (.15-.24)	.29 (.22-.43)
Time II (N = 5, Mean of 78 utterances with a Verb per child)		
.15 (.08-.18)	.14 (.06-.23)	.29 (.18-.41)